OPERATOR, INSTRUCTION AND SERVICE MANUAL

VERSATONE®

DOPPLER ULTRASOUND INSTRUMENT

MODEL D8

LISTED UL 178T

Listed under the Underwriters Laboratory standard 544 for medical and dental equipment.

SERIAL NUMBER_____

DOCUMENT NO. 054-0123-020 REV. D

MEDASONICS®

47233 Fremont Blvd., Fremont, CA 94538

(800) 227-8076

APRIL 1995

WARRANTY AND FACTORY SERVICE INFORMATION

FULL WARRANTY

MedaSonics, Inc. warrants that your MedaSonics VERSATONE Model D8 is free from defective material and workmanship. Our obligation under this warranty is limited to the repair of instruments returned to us, transportation charges prepaid, within one year after delivery to the original purchaser. Specifically, we agree to service and/or adjust any instrument as required if returned for that purpose and to replace or repair any part which, upon our examination, is proved to have been defective. This warranty does not apply to batteries, or equipment damaged through shipping, tampering, negligence or misuse, including liquid immersion and autoclaving. THE FOREGOING WARRANTIES ARE EXCLUSIVE AND ARE IN LIEU OF ALL OTHER WARRANTIES (whether written, oral or implied). MedSonics is not liable for consequential damages.

This service manual is intended for use as a guide to technically qualified personnel when evaluating instrument malfunctions. It is not to be construed as authorization to perform warranty repairs. Unauthorized service will void the warranty. Instruments requiring warranty repairs must be shipped, postpaid, to the factory. MedaSonics also provides prompt, factory service for out of warranty repairs. Where possible, we suggest using the original carton and packing to insure the safe return of any instrument.

If you have questions about your VERSATONE D8 instrument or its service please call the Service Manager. The toll-free phone number is 800 227-8076.
In Alaska, call collect (510) 623-0626
Address correspondence as follows:

Service Manager
MedaSonics, Inc.
P.O. Box 4903
Fremont, CA 94539

If the equipment is to be returned for service, please send it prepaid and insured in the original carton to the following address:

MEDASONICS SERVICE CENTER

47233 Fremont Blvd., Fremont, CA 94538

(800) 227-8076

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INTRODUCTION

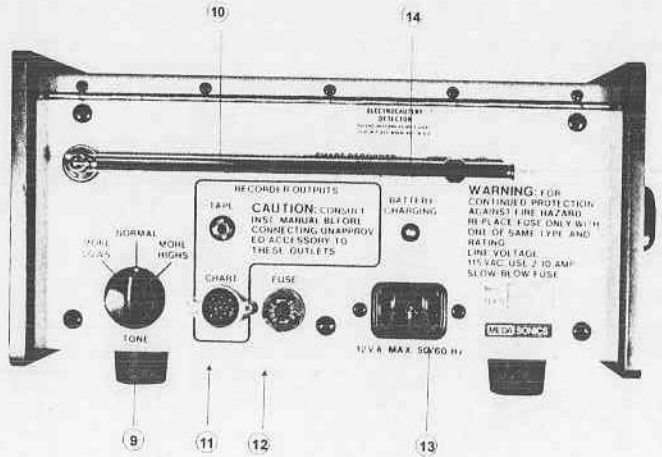
This service manual pertains to the MedaSonics VERSATONE® Doppler instrument Model D8. This instrument is the central unit of an ultrasound system that uses the Doppler effect to detect blood flow and other motion within the body. Four interchangeable plug-in probes (Models P81, P82, P83, P84) are available for use with the VERSATONE.

This manual provides sufficient information to enable a trained electronics technician to trouble-shoot and repair the VERSATONE Model D8. The plug-in probes cannot be serviced in the field and therefore this manual contains no information on them. Should a probe malfunction the entire probe assembly including the plug-in unit, the connecting cable and the transducer must be returned to the factory for service.

Before attempting to service the VERSATONE Model D8 it is necessary that the technician become familiar with the operation of the instrument by reading the operating instructions booklet. If a copy of this booklet is not available one can be obtained free of charge by phoning or writing the MedaSonics Service Manager.

The Illustrated Description on this page identifies the various controls, inputs and outputs of the VERSATONE Model D8.

FRONT PANEL
(Figure 1)



REAR PANEL
(Figure 2)

ILLUSTRATED DESCRIPTION

FRONT PANEL (Figure 1)

1. Main Switch: Three positions—*ON*, *STAND BY* and *TIMED-ON*.
2. Start Button: Push to start timed operation when front panel switch is in *TIMED-ON* mode.
3. Volume Control: Controls the level of the sound from the loudspeaker or headset.
4. Probe Receptacle: Probe units are designed to plug into this receptacle.
5. **Headset Jack:** MedaSonics headset Model SH3A may be plugged into this jack for private listening.
6. **Loudspeaker:** Operates whenever the instrument is turned on, except when a headset is plugged in.
7. **Low Battery Indicator:** When the battery pack has been nearly exhausted, the low battery indicator light comes on and a beeping sound is generated.
8. **Storage Space Cover:** Lift cover for access to space for storing the power cable, probes, and small accessories.

REAR PANEL (Figure 2)

9. **Tone Control:** Three positions—*MORE LOWS*, *NORMAL* and *MORE HIGHS*. The *NORMAL* position should usually be selected.
10. **Tape Recorder Output:** Tape recordings of Doppler sounds may be made with most recorders. Use HW1069 cable.
11. **Chart Recorder Output Connector** Provides output signal for chart recording on those instruments fitted with Option 03.
12. **2/10 Slow-Blow Fuse:** (3AG) (Specially labeled 220 volt units use 1/10 amp slow-blow fuse.)
13. **Power Cable Receptacle:** A detachable 7-foot, 3-wire grounded cable with hospital grade connector is provided with the VERSATONE. The battery is charging whenever this cable is connected to a power source.
14. **Battery Charging Indicator:** This light is on whenever the battery pack is receiving a charge.

THEORY OF OPERATION

INTRODUCTION

The MedaSonics VERSATONE® Doppler Model D8 has two printed circuit board assemblies: the Amplifier board and the Power Supply board. One of several available front panel plug-in probe assemblies is also required to operate the instrument. There are three internal options available: the Electrocautery Cut-Out (Option 01), 230 volt operation (Option 02) and a Chart Recorder Circuit (Option 03). These options can easily be added as required by service personnel. For identification and location of these circuit boards see the photo on page 10.

The Doppler signal can be traced through its entire process on the circuit block diagram (page 12). The circuit board interconnecting wires are shown on the terminal designation diagram (page 20). Detailed circuit diagrams are provided for each circuit of the Model D8 (pages 13,15,17). Opposite each of the circuit diagrams is a layout of the corresponding printed circuit board.

AMPLIFIER (circuit diagram page 13)

The amplified rf receive signal from the plug-in probe enters the amplifier board through J1, 7, 8, and is detected by CR1 and CR2. RFI filter L1, C25 is to reduce interference from radio transmissions in the FM-TV band. The resultant low level audio signal is amplified by Q1 and fed to the input of A1 at pin 3. A1 is a uA-748 operational amplifier. The high frequency response of A1 is tailored to each of the P80 series plug-in probes by an RC filter within the probe PC assembly (through J1, –11, 12 to ground). The gain of the amplifier and its low frequency response is also set in the same manner through J1, –13, 14. Volume control P2 controls the feedback around A1. The output of the audio pre-amplifier A1 is filtered by the RC network selected by switch S3 located on the rear panel. From the emitter of buffer transistor Q2 the filtered Doppler audio is available at the rear panel by J4 for recording on a standard audio tape recorder and at the front panel by J6 for monitoring with a headset. When a headset is used in J6, the power amplifier input is disconnected. The LM 380 is a 2.5 W audio power amplifier used to drive the speaker.

Dual operational amplifier MC1458 is used as a visual and audible low battery warning circuit. One of the op-amps, A3a, is wired as a voltage comparator using CR3 to establish a reference voltage. The comparator voltage is set at the factory by adjusting P1, so that the comparator turns on when the battery voltage drops to 11 v DC. The output voltage from this comparator energizes LED-1 on the front panel, and allows the PUT oscillator Q3 to run when pulsed by A3b. A3b is used as an astable, asymmetrical multivibrator producing a short duration pulse approximately every 15 seconds. The 1 KHz signal pulses go to the negative input of A2, the audio output amplifier.

POWER SUPPLY (circuit diagram page 15)

The basic power supply circuit of this PC board is a full wave rectifier providing approximately +20V DC unregulated. Power transistor Q1 provides a constant 100 MA to the battery pack. Ten nickel cadmium batteries rated at 1.2V DC each are combined in series to produce a total of 12V DC nominal. Individual cells in this battery pack may be replaced, but after a number of years it would be best to order a replacement battery pack. The VERSATONE battery pack can be recharged while it is being used with little loss of charging current to the battery pack. To accomplish this Q2 is turned on while the VERSATONE is in use to cause Q1 to conduct more, maintaining a constant 100 MA to the battery pack.

A low current programmable operational amplifier (A1) is used as a voltage comparator in a battery overdischarge protection circuit. Mercury battery B1 provides a reference voltage at pin 3 and while the voltage at pin 2 remains more positive than pin 3, the comparator output will be low. When the battery pack voltage drops below 10.4V, the trigger level at pin 2 (set by P2) then drops below that of pin 3 and the comparator output will be a positive value; turning on Q5 and Q6 off. This will then turn off Q4 and the VERSATONE, preventing further discharge of the battery pack. The VERSATONE will remain off until the power cord is reattached bringing the voltage back up on pin 2 as well as charging the battery pack. NOTE: The NiCad battery pack voltage will experience a spontaneous recovery after the protection circuit shuts the VERSATONE off. This will reactivate the VERSATONE for a very short time after which it will again switch off. The resulting periodic "popping" of a unit left on indefinitely is a normal occurrence and calls further attention to the fact that a battery charge is needed.

With S2 in position two (TIMED-ON) the VERSATONE will remain on for one minute nominal when activated by S1. S1 turns on transistors Q3 and Q4. C3 initially has no charge, having discharged via CR6 and the load on terminal VS when the VERSATONE was previously turned off. When Q4 turns on, the +12V at VS is applied via C3 to the base circuit of Q6, holding Q4 on. Then C3 slowly charges via R31, 33, 13, 17 until, after 1 minute, Q6 turns off, turning off Q4 and shutting down the VERSATONE.

ELECTROCAUTERY CUT-OUT (OPTION 01 circuit diagram page 17)

The electrocautery cut-out circuit is essentially a low frequency wide band rf amplifier and transistor switch. Transistors Q1 and Q2 are in cascade as a high gain rf amplifier whose output is detected by CR3 and CR4. Diodes CR1 and CR2 are used to protect the input from excessively high rf voltages. Capacitor C6 tends to roll off the upper frequency limit at about 1 MHz. Switching transistors Q3, Q4 and Q5 are effectively a squelch circuit that deactivate the buffer transistor Q2 on the amplifier circuit board thus preventing the electrocautery interference from reaching the headset jack and speaker.

MAINTENANCE AND OPTION INSTALLATION

SERVICE ACCESS

CAUTION: There are exposed power line voltages within the instrument. The ni-cad battery pack is capable of very high discharge currents should a direct short occur. Access and repair should be undertaken only by an authorized, competent, trained electronic technician.

Remove power cord from the AC receptacle on the rear panel. To gain access to the printed circuit boards, first remove the accessory tray located under the hinged cover. To do this remove the six screws labeled "A" through "F" (see Fig. 1). If the VERSATONE has the electrocautery cut-out circuit (Option 01) as indicated by a label on the rear panel, then remove screw "G". If it has a chart recorder circuit (Option 03) also indicated by a label on the rear panel, then remove screw "H". NOTE: If Options 01 or 03 are not installed in this unit then DO NOT remove screws "G" and "H". The accessory tray may still be partially held down by the silicon rubber used as a vibration damper. Pry the tray out but do not remove the rubber that adheres to the tray or chassis. The location of the circuit boards is shown in the photograph on page 11.

AMPLIFIER BOARD

To gain access to the component side of the amplifier board, carefully remove the five front panel screws. NOTE: Both the front and rear panels have a screw located at the top center and accessible from the inside only. The panels are partially held in place by silicon rubber and must be pulled or pried away from the chassis.

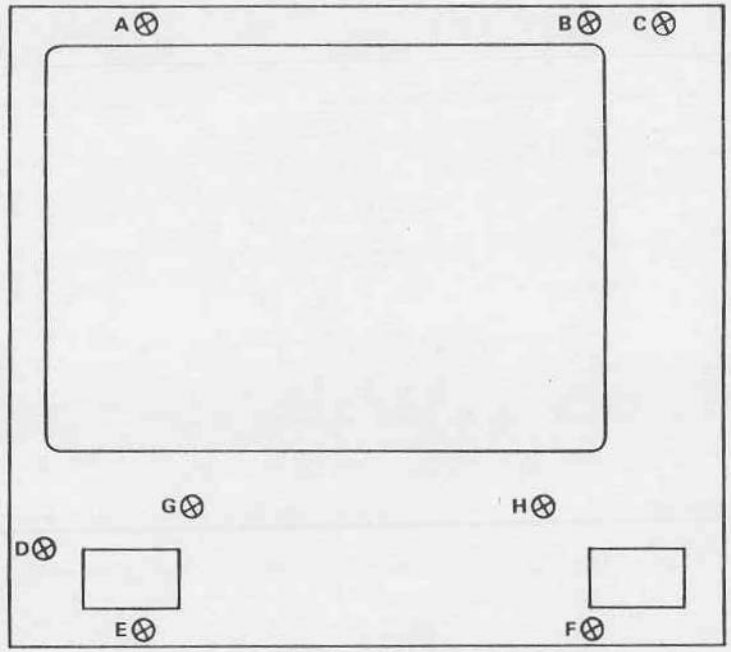
Most component replacement and troubleshooting can take place without removing the amplifier board. If it is necessary to remove this board, begin by removing the screw from the angle bracket on the lower edge of the board, and the two screws on the bottom of the black connector bracket (see photo page 11). Next remove the two flat head screws from the aluminum bar and lift the amplifier circuit board away from the chassis. If the VERSATONE is equipped with the electrocautery or chart recorder circuits, be sure to unplug them from the main amplifier board before attempting to remove it.

POWER SUPPLY

As shown in the photograph (page 11) the component side of the circuit board is readily accessible. To gain access to the foil side of the power supply circuit board, remove the four nuts from the corners and lift the board away from the mounting studs.

ELECTROCAUTERY CUT-OUT (Option 01)

To service the electrocautery cut-out circuit board, remove the two screws that attach the board to the chassis through the angle brackets. Lift the board clear of the chassis. To install this optional circuitry reverse the process and plug into



ACCESSORY TRAY LAYOUT
(Figure 3)

the amplifier circuit board as shown in the photograph (page 11). This board can remain plugged into the amplifier board when pulled out for service.

BATTERY PACK

To remove the battery pack for repair or replacement, disconnect the leads from the positive and negative terminal connectors and remove the four corner screws from the bottom of the chassis (see photo page 11). Lift the battery pack up and slide it out from under the speaker.

SPEAKER

To replace the speaker remove the four screws which secure the small rubber feet and the end panel. This gives access to the speaker fasteners.

TROUBLESHOOTING

Localize the defective stage of the VERSATONE with the use of the circuit block diagram (page 12). NOTE: If the trouble is traced to the plug-in probe assembly it must be returned to the factory for service.

THE BATTERY SYSTEM

The nominal voltage is +12V DC. The nominal capacity is 1 Amp hour. Charging current is 100±20 mA (unit off). The battery voltage may be checked at pin 6 of the rear panel "AUX" jack, with the instrument turned on. If the unit will not go on, then this voltage must be checked at the battery terminals. Charging current may be monitored by placing a milliameter in series with the +12V lead from the battery pack. When replacing the slip-on battery connector, make sure the contact is firm. A true test of battery condition may be obtained by fully charging the battery, and then discharging it at a known rate for a known time (100 ma for 10 hours). When replacing a battery pack, it is a good idea to replace the mercury reference cell (B1) at the same time. This battery is supplied with plug-in pins attached and simply plugs into the circuit board. In older models these pins must be soldered to stake terminals on the PC board. **Be sure to observe correct polarity when installing replacement batteries.**

THE AMPLIFIER CIRCUIT

Test points are shown on the schematic diagram (page 13). If there is a loss of Doppler sounds from the speaker, the defective stage can be isolated by using a plug-in probe as a signal source. First, determine if the transmitter in the probe is operating by the signal at test point (tp) "T". The approximate frequencies of the plug-in probes are as follows: P81 2.4 MHz, P82 and P83 8 MHz, P84 5.3 MHz. At test point "S" there is rf coming from the output of the receiver rf amplifier. The detected rf signal can be picked up at test point "X". The output of the audio pre-amplifier can be visualized at terminal lug "C". Terminal "J" is used to observe the input of the audio power amplifier IC and its output at terminal "M". At terminal lug "K" a slow sawtooth waveform appears each time the multivibrator triggers the "PUT" oscillator Q3. NOTE: This battery warning circuit operates only when V_s drops below 11.5V DC. Some typical DC voltages are shown in the charts on page 9.

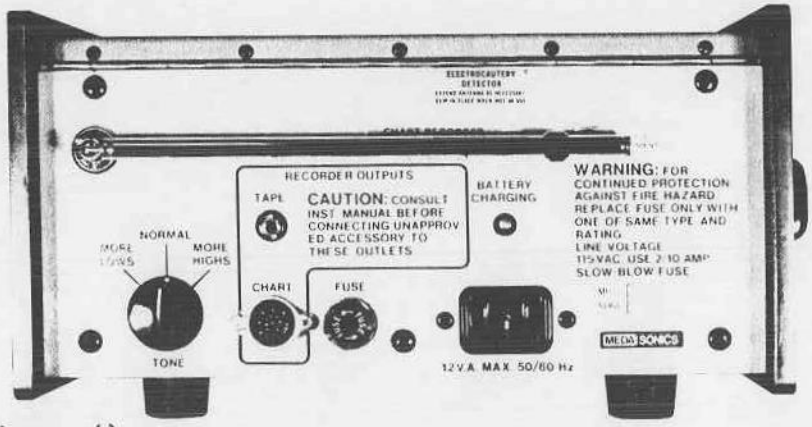
ADDITIONAL TESTS

NOTE: The power cord and receptacle ground connection should be tested periodically and should read less than 0.1 OHM to chassis ground. The gasket on the input power receptacle should be inspected for cuts or wear and replaced as necessary. The plug-in probes should be periodically inspected for insulation integrity.

ELECTROCAUTERY CUT-OUT (Option 01)

If the electrocautery cut-out circuit fails to operate be sure the antenna is unclipped from its holding clip, rotated vertically and fully extended. In case cut-out still does not occur in the presence of interference, move the VERSATONE or the antenna closer in proximity to the electrocautery device. NOTE: Not all electrocauteries radiate sufficient energy to activate the cut-out circuit, and bipolar electrodes radiate less also. It may be necessary to clip on a 3 or 4-foot length of wire to the antenna to increase the circuit sensitivity. In turn, the sensitivity may be reduced by partially collapsing the antenna. In rare instances the sound cut-out may be activated by other sources of radio frequency energy, such as rotating machinery or powerful nearby AM broadcast radio transmitters.

To accurately determine the sensitivity of the cut-out circuit, apply a 750 kHz, 40 mV pp signal between the antenna and ground. The cut-out should operate at this input level so that no Doppler signal comes through the VERSATONE loudspeaker. To aid in troubleshooting the electrocautery cut-out circuit, refer to the chart of bias voltages on page 9.



(Figure 4)

VIEW OF REAR PANEL WITH OPTION 01 ELECTROCAUTERY CUT-OUT ANTENNA INSTALLED

TYPICAL DC POWER VOLTAGES (Table 1)

POWER SUPPLY CIRCUIT

	E	B	C	
Q1	19.54	18.8	12.82	Battery charging, VERSATONE "STANDBY"
Q1	18.70	17.9	12.83	Battery charging, VERSATONE "ON"
Q2	0	0.2	18.9	VERSATONE "STANDBY"
Q2	4.17	4.7	17.9	VERSATONE "ON"
Q3	12.13	12.0	0	"STANDBY"
Q3	12.13	11.55	12.16*	"TIMED ON"
Q4	12.13	12.17	0	"STANDBY"
Q4	12.13	11.48	12.13	"ON"

*Decays for 1 minute.

LOW BATTERY CUT-OUT CIRCUIT

(NOTE: Battery voltage must be +10.4V DC to activate)

Pin	2	3	6	7	8
A1	1.3	1.3	8.52	10.4	8.5

	E	B	C
Q5	0	.519	.032
Q6	0	.032	10.4

AMPLIFIER CIRCUIT

(NOTE: Battery voltage +12 V DC and P81 Probe Plugged-in)

	E	B	C
Q1	10.5	9.86	5.71
Q2	5.08	5.57	11.6

Pin	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A1	–	5.74	5.72	0.0	5.74	5.74	11.48	5.17	–	–	–	–	–	–
A2	6.18	.01	–	–	–	–	–	6.01	–	–	–	–	–	12.0

LOW BATTERY WARNING CIRCUIT

(NOTE: V_S must be +11.5V DC to activate low battery circuit)

Pin	1	2	3	4	5	6	7	8	
A3	8.54	4.7	4.8	0	3.5	7.0*	2.02	11.5	(no audible tone)
A3	8.54	4.7	4.8	0	7.0	3.6	10.8	11.5	(audible tone)

	C	A	G	
Q3	0	2	5.5	(no audible tone)
Q3	0	4.5	5.3	(audible tone)

*Decays to 3.6 V

ELECTROCAUTERY CUT-OUT CIRCUIT (Revision A)

Q1	4.0	4.55	8.53	
Q2	2.16	2.7	4.0	
Q3	12.0	11.7	0.0	OFF
Q3	12.0	11.4	12.0	ON
Q4	0.0	0.0	12.0	OFF
Q4	11.39	11.93	12.0	ON
Q5	0.0	0.0	5.6	OFF
Q5	0.0	0.59	0.0	ON

POWER SUPPLY CALIBRATION

Calibration of the VERSATONE power supply is performed to control the charging of the internal battery pack. The low voltage warning circuit is calibrated first. Pull off the positive (red) lead (see page 11) from the battery pack and connect it to a variable voltage 500 mA capacity power supply. Set the variable power supply to +11.5V DC and adjust P_1 on the amplifier circuit board so that the low battery LED on the front panel "just turns on." (NOTE: The low voltage beeper should be heard about once every 15 seconds, after the LED turns on.) Readjust the variable power supply to +12V DC, the LED should turn off and the beeper stop. Now vary the power supply through +11.5V DC to verify that the low voltage warning circuit turns on at this voltage. Readjust P_1 as necessary.

The over discharge cut-out protection circuit is calibrated next. Set the variable power supply to +10.4V DC. Adjust P_2 on the power supply circuit board so that the low battery LED and beeper "just turns off." Increase the variable power supply to +11.0V DC and readjust it back through +10.4V DC to be sure the LED turns off at that voltage. Readjust P_2 as necessary. Replace the positive lead to the battery pack positive terminal. Make sure the slip-on connector grips the slip-on terminal securely.

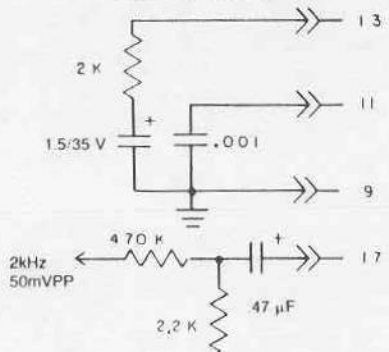
AMPLIFIER CALIBRATION

Plug in test adapter shown below. Apply a 50 mVPP, 2 kHz signal to the adapter. With the VERSATONE volume full clockwise and the tone switch to "NORMAL" the voltage at the headset jack J6 should be 200 mVPP typical. Now adjust P3 for 4.5 VPP at terminal M (not at the speaker).

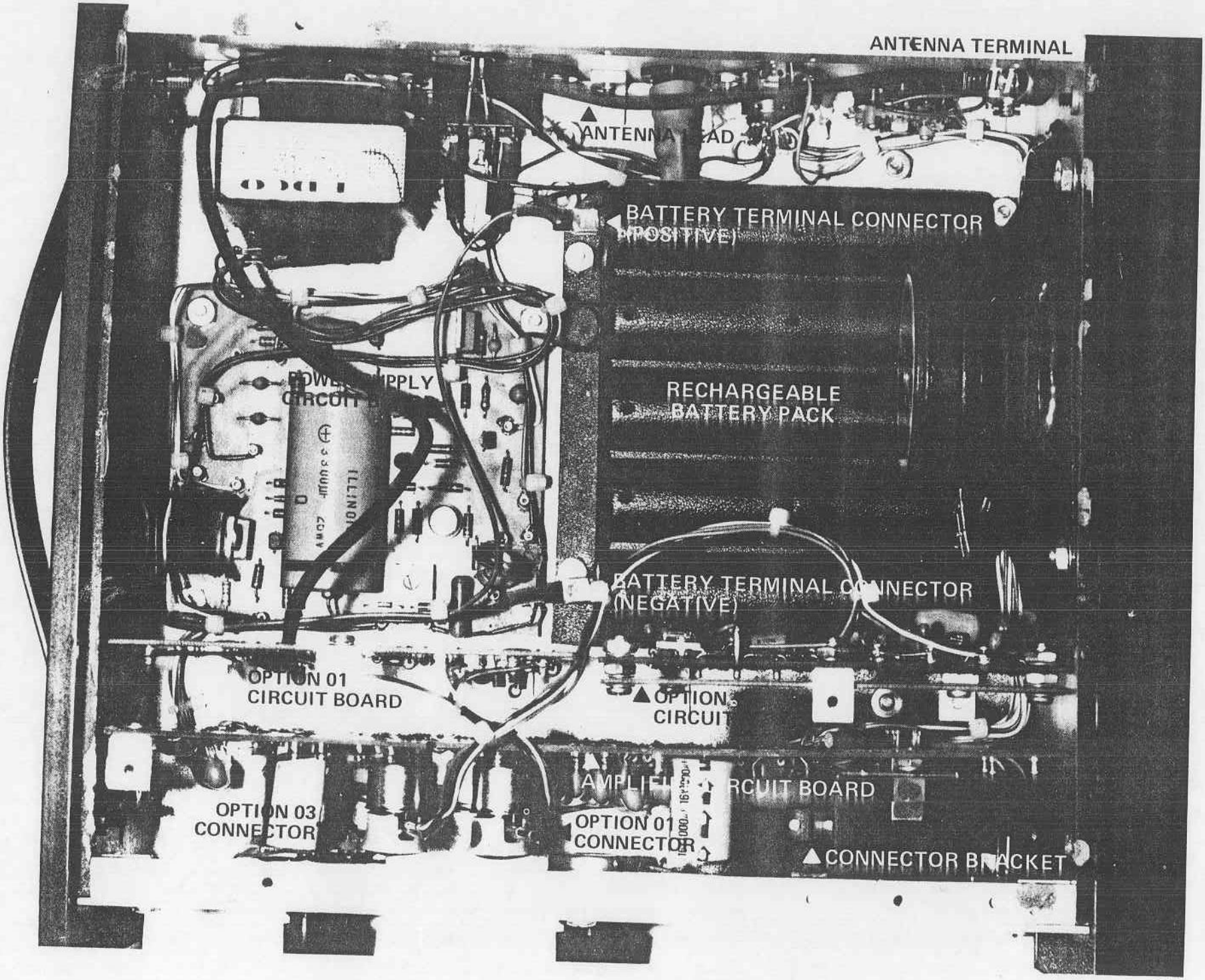
Disconnect the signal generator but leave the plug-in adapter connected. Observe the noise level at the speaker; it should be 12 mV rms typical.

Alternately the gain can be set without the use of test equipment. Plug in a P80 series probe and adjust P3 for the loudest maximum signal consistent with stable, distortion-free operation.

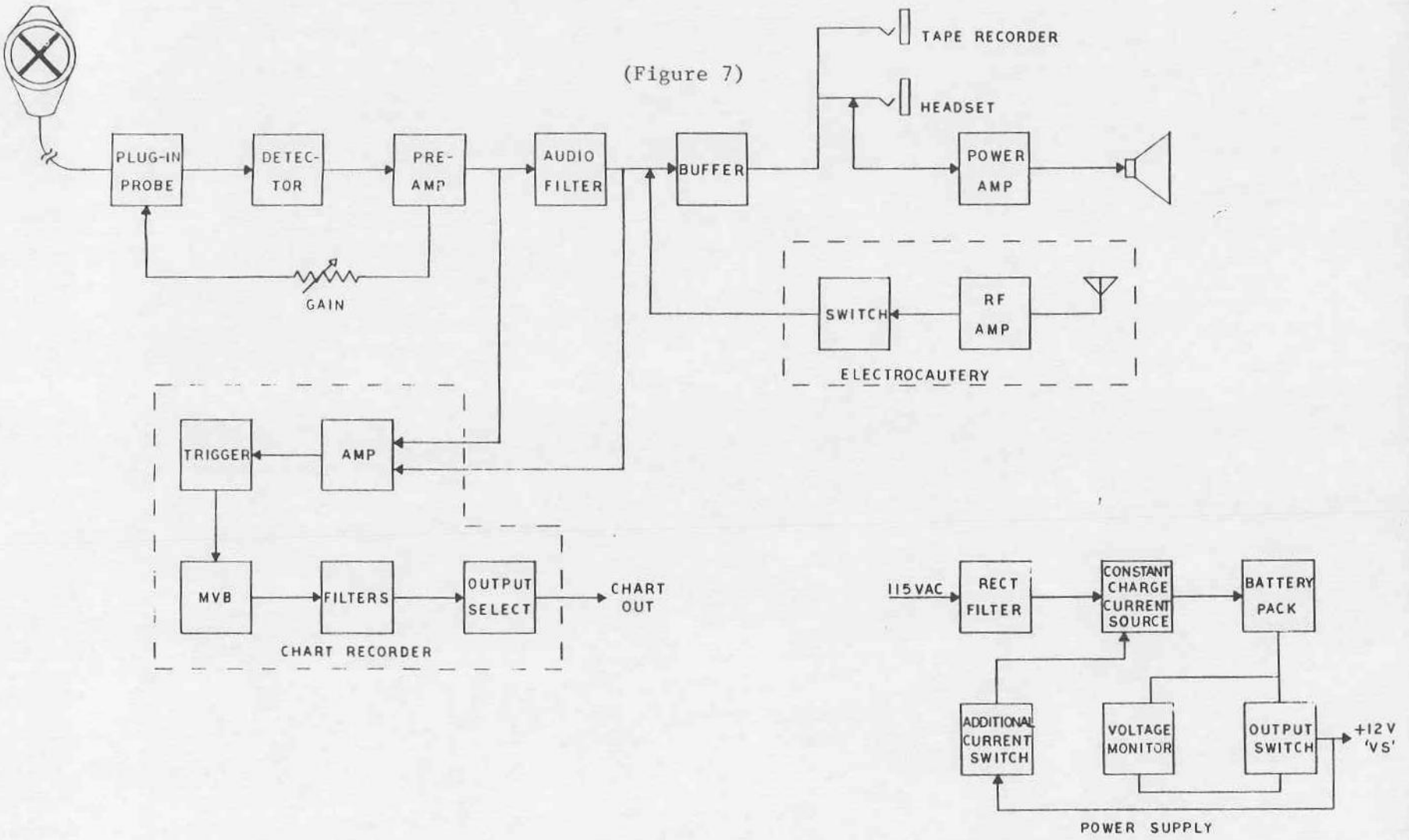
PLUG-IN TEST ADAPTER



MAJOR ASSEMBLIES
(Figure 6)

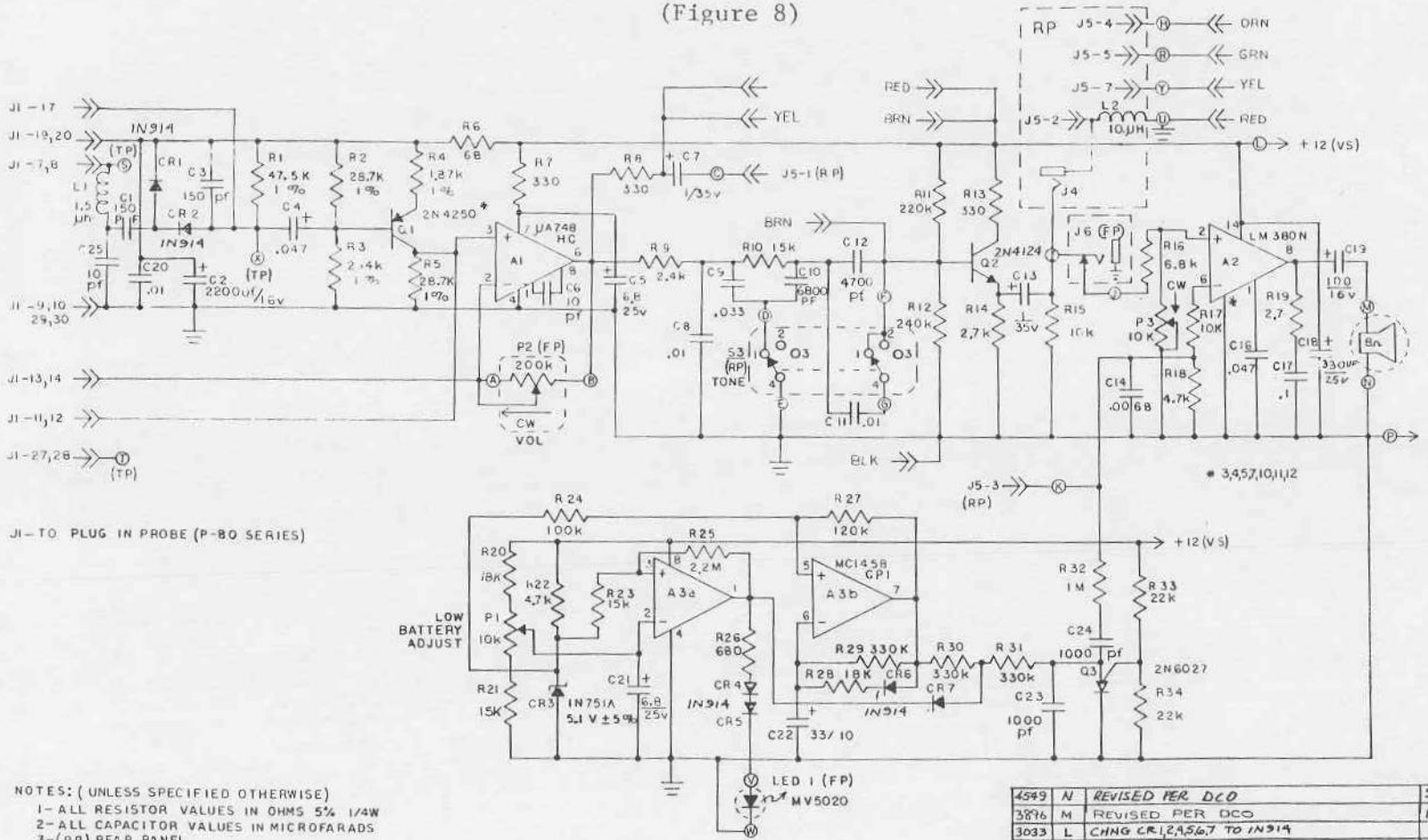


(Figure 7)



MEDSONICS INC		
SCALE:	APPROVED BY: JWolf	DRAWN BY J Kakuk
DATE: 9-2-75		REVISED
D-8 BLOCK DIAGRAM		
		DRAWING NUMBER

(Figure 8)



NOTES: (UNLESS SPECIFIED OTHERWISE)
1-ALL RESISTOR VALUES IN OHMS 5% 1/4W
2-ALL CAPACITOR VALUES IN MICROFARADS
3-(RP) REAR PANEL
4-(FP) FRONT PANEL
5-AN ASTERISK DESIGNATES A FACTORY SELECTED PART.
6-ITEMS ENCLOSED IN DOTTED LINES NOT ON PC BRD.

LAST USED	NOT USED
J6	
R34	
C25	C15
CR7	
Q3	
A3	
LED1	
P3	
S3	
V	
L2	

S3 TONE

REAR

1-MORE LOWS
2-NORMAL
3-MORE HIGHS

AUXILIARY JACK (REAR PANEL) J5

PIN		THIS PC	PWR PC
KEY	GROUND (LUG B)		
1	DOPPLER AUDIO	C	
2	GROUND	U	
3	MARK IN ULTRASTETH IN	K	
4	CHART REMOTE CAL.		E-6
5	CHART SIGNAL OUT	R	
6	VS (+12v SWITCHED ON)		E-8,12
7	CAUTERY CUT OUT (REMOTE)	Y	

KEY
J5
(PLUG END)

ECN	LTR	DESCRIPTION	DATE	APPROVED
4549	N	REVISED PER DCO	9-30-92	K Williams
3896	M	REVISED PER DCO	10-2-91	K. Williams
3033	L	CHNG CR1,2,4,5,6,7 TO IN914	2-27-86	K. Bache
438	K	R20 WAS 30K, IS 18K	10-10-79	[illegible]
289 312	J	C2 WAS C1000 MF/16V DOCUMENT NUMBER CHANGED	9-25-78	[illegible]
130	H	Q2 WAS GET 3415, IS GES 3415	9-27-78	[illegible]
173	G	C19 WAS 100µF 16V, IS 100µF 16V	6-22-77	[illegible]
70	F	R21 WAS 22K, IS 15K, H334 UP	12-17-76	[illegible]
98	E	CHANGED R1,5,16,17,18; DELETED C15; ADDED P3	7-26-76	K. B
56	D	ADDED L2 AT J4,5. S.N. H309 & UP.	7-23-76	KGJ
25	C	MOVED J3-3 & TERM. (H), H232	12-10-75	KGJ
19	B	CHANGED J5-2,4, S.N. H152.	8-14-75	KGJ
1	A	ADD L1, C25; REDRAWN, S.N. H107.	2-28-75	JZW

REVISIONS

103-0007-010	D8
NEXT ASSY.	USED ON
APPLICATION	

MEDASONICS

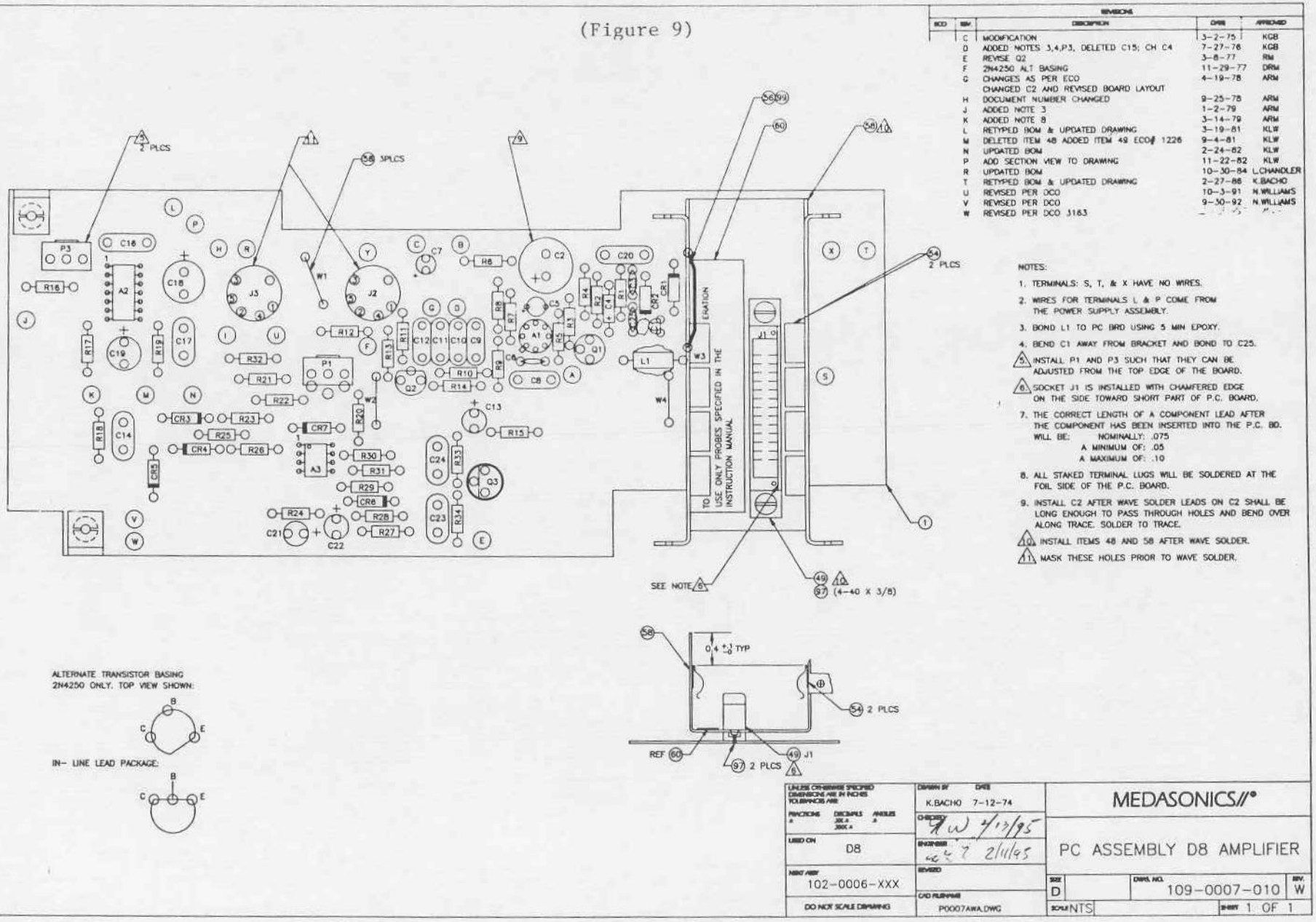
SCALE:	APPROVED BY: JZW 5-7-75	DRAWN BY
DATE: 1-20-75		REVISED

SCHEMATIC, AMPLIFIER

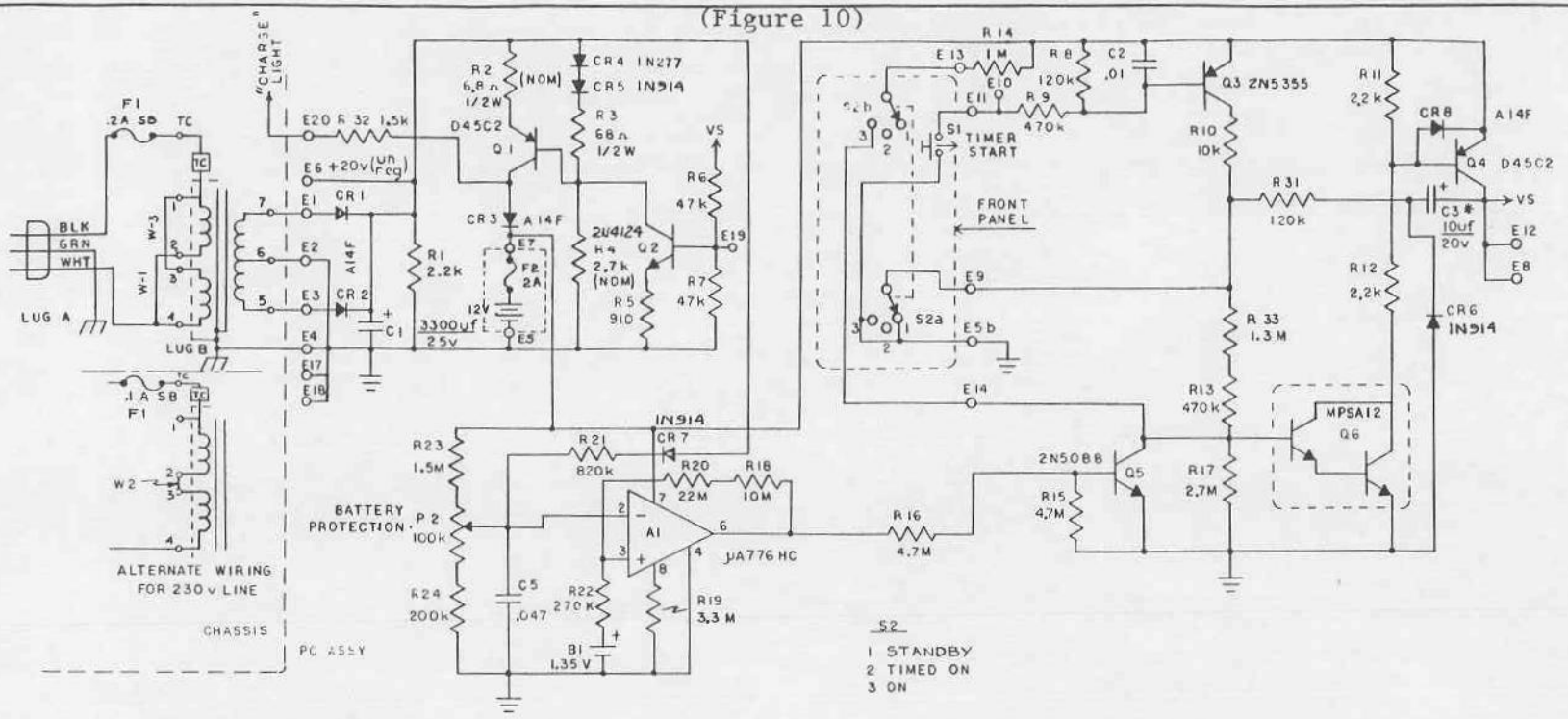
DRAWING NUMBER C11-0007-010

REV N

(Figure 9)


REVISIONS
ECO | REV | DESCRIPTION | DATE | APPROVED
C | MODIFICATION | 3-2-75 | KGB
D | ADDED NOTES 3,4,P3, DELETED C15; CH C4 | 7-27-76 | KGB
E | REVISE Q2 | 3-8-77 | RM
F | 2N4250 ALT BASING | 11-29-77 | DRM
G | CHANGES AS PER ECO | 4-19-78 | ARM
CHANGED C2 AND REVISED BOARD LAYOUT
H | DOCUMENT NUMBER CHANGED | 9-25-78 | ARM
J | ADDED NOTE 3 | 1-2-79 | ARM
K | ADDED NOTE 8 | 3-14-79 | ARM
L | RETYPED BOM & UPDATED DRAWING | 3-19-81 | KLW
M | DELETED ITEM 48 ADDED ITEM 49 ECO# 1226 | 9-4-81 | KLW
N | UPDATED BOM | 2-24-82 | KLW
P | ADD SECTION VIEW TO DRAWING | 11-22-82 | KLW
R | UPDATED BOM | 10-30-84 | L.CHANDLER
T | RETYPED BOM & UPDATED DRAWING | 2-27-86 | K.BACHO
U | REVISED PER DCO | 10-3-91 | N.WILLIAMS
V | REVISED PER DCO | 9-30-92 | N.WILLIAMS
W | REVISED PER DCO 3183
NOTES:
1. TERMINALS: S, T, & X HAVE NO WIRES.
2. WIRES FOR TERMINALS L & P COME FROM THE POWER SUPPLY ASSEMBLY.
3. BOND L1 TO PC BRD USING 5 MIN EPOXY.
4. BEND C1 AWAY FROM BRACKET AND BOND TO C25.
5. INSTALL P1 AND P3 SUCH THAT THEY CAN BE ADJUSTED FROM THE TOP EDGE OF THE BOARD.
6. SOCKET J1 IS INSTALLED WITH CHAMFERED EDGE ON THE SIDE TOWARD SHORT PART OF P.C. BOARD.
7. THE CORRECT LENGTH OF A COMPONENT LEAD AFTER THE COMPONENT HAS BEEN INSERTED INTO THE P.C. BD. WILL BE: NOMINALLY: .075
A MINIMUM OF: .05
A MAXIMUM OF: .10
8. ALL STAKED TERMINAL LUGS WILL BE SOLDERED AT THE FOIL SIDE OF THE P.C. BOARD.
9. INSTALL C2 AFTER WAVE SOLDER LEADS ON C2 SHALL BE LONG ENOUGH TO PASS THROUGH HOLES AND BEND OVER ALONG TRACE. SOLDER TO TRACE.
10. INSTALL ITEMS 48 AND 58 AFTER WAVE SOLDER.
11. MASK THESE HOLES PRIOR TO WAVE SOLDER.
TO USE ONLY PROBES SPECIFIED IN THE INSTRUCTION MANUAL
SEE NOTE 6
(4-40 X 3/8)
0.4 +.1 -.0 TYP
REF
2 PLCS
J1
3 PLCS
ALTERNATE TRANSISTOR BASING
2N4250 ONLY. TOP VIEW SHOWN:
IN- LINE LEAD PACKAGE:
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
USED ON D8
NEXT ASSY 102-0006-XXX
DO NOT SCALE DRAWING
DRAWN BY K.BACHO 7-12-74
CHECKED 4/17/95
ENGINEER 2/11/95
REVISED
CAD FILENAME P0007AWA.DWG
MEDASONICS
PC ASSEMBLY D8 AMPLIFIER
SIZE D
DWG. NO. 109-0007-010
REV. W
SCALE NTS
SHEET 1 OF 1

(Figure 10)



NOTES:(UNLESS SPECIFIED OTHERWISE)

1-WIRED FOR 115vAC (JUMPERS W1 AND W3)
2-VS (VOLTAGE SWITCHED)
3-ALL RESISTOR VALUES IN OHMS 5%1/4W
4-ALL CAPACITOR VALUES IN MICROFARADS
5-ITEMS ENCLOSED IN DOTTED LINES NOT ON PC BOARD EXCEPT Q6.
6-AN ASTERISK '*' DESIGNATES A FACTORY SELECTED PART.

LAST USED	NOT USED
R33	C4
C5	R25-R30
A1	E15,16
B1	
Q6	
CR8	
P2	
E20	
S2	

ECN	LTR	DESCRIPTION	DATE	APPRO.
3895	M	REVISED PER ECO	7-8-91	K. Banks
3033	L	CHANGE CR567 TO IN914	2-27-86	K. Banks
2843	K	CHANGE Q3 TO ZN TYPE	5-9-85	S. Manley
366	J	CHANGES AS PER ECO	3-20-79	RMM
312	H	DOCUMENT NUMBER CHANGED	9-25-78	RMM
130	G	Q2 WAS GET, 15 GES / Q3 WAS GET, 15 GES	9-27-78	
265	F	R5 WAS 1.2K / IS 910	4-18-78	
99	E	POWER TRANSFORMER CHANGE	12-22-76	
42	D	R19 WAS 2.2M IS 3.3M, S.N. H257.	2-26-76	
41	C	RELOCATED R14, S.N. H257.	1-23-76	
19	B	REMOVED J5-4 FROM E6, S.N. H152.	8-15-75	
	A	REDRAWN	1-10-75	

REVISIONS

MEDASONICS

SCALE:
DATE: 1-10-75
APPROVED BY: JW 5-9-75
DRAWN BY
REVISED

SCHEMATIC, POWER SUPPLY, D8

109-0011-010	D8
NEXT ASSY	USED ON
APPLICATION	

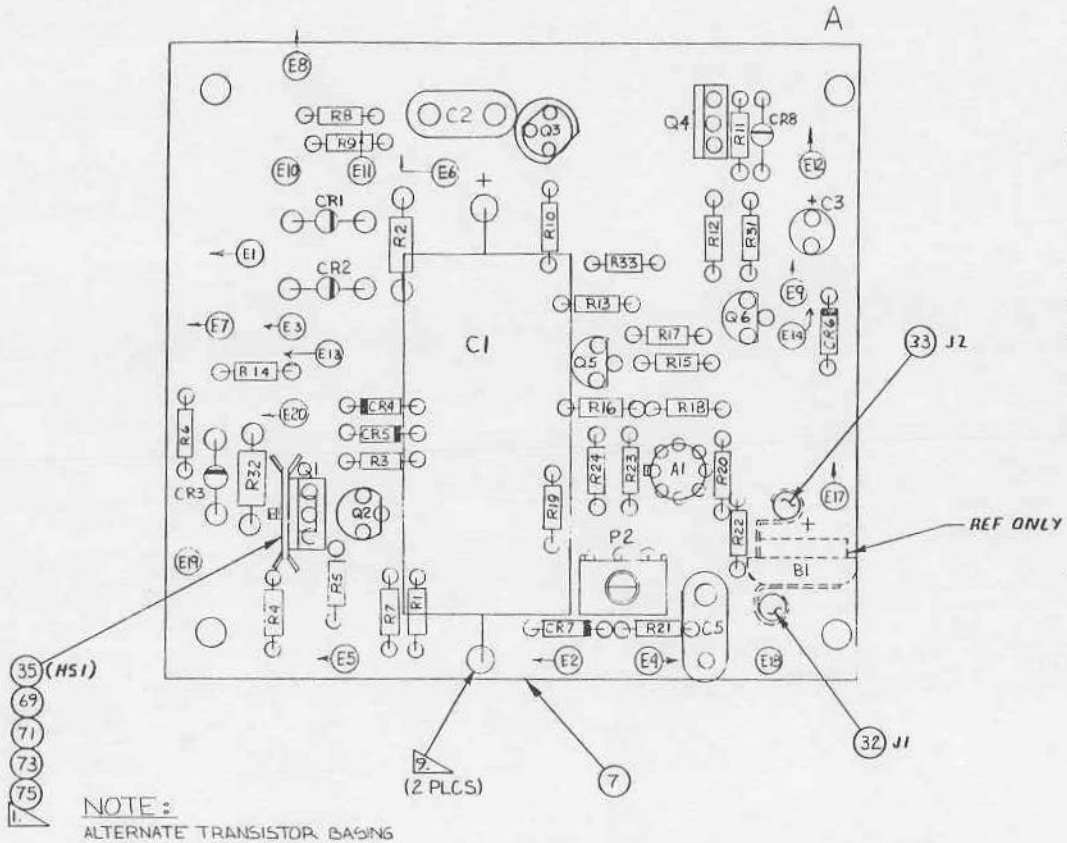
REV. M

DRAWING NUMBER 011-0011-010

ECO	REV	DESCRIPTION	DATE	APPROVED
3895	T	REVISED PER ECO	7-8-91	K. Bacho
4549	V	REVISED PER ECO	9-30-92	A. Williams

(Figure 11)

REVISION				
ECO	LTR	DESCRIPTION	DATE	APPROVED
5	A	WIRING CHANGE. S.N. H107.	3/4/75	Ap!
41	B	RELOCATE R14, E13&14 SN.H257.	1-16-76	RAP
150	C	REVISED Q2,3	3-8-77	
215	D	ALT. BASING. 2N4250	11-29-77	
312	E	DOCUMENT NUMBER CHANGED	9-25-78	
328	F	ADDED NOTE 9.	12-28-78	
328	G	ADDED NOTE 10.	1-2-79	
361	H	ADDED NOTE 11	3-14-79	
366	J	CHANGES AS PER ECO	3-20-79	
938	K	ITEM Nº ADDED AND BOM RETYPED	5-1-81	TW
1576	L	UPDATED BOM	12-22-81	
2709	M	UPDATED BOM	10-30-84	
2827	N	ADD DETAIL A AND NOTE 12	4-17-85	
2843	P	REV. NOTE 12	5-9-85	
3093	R	CHNG DIODES TO IN914	2-27-86	K. Bacho
	S	DELETE NOTE 7 PER ECO 3530	10/20/89	



NOTES: * NOTES 2,3,4,5,6,& 8 ARE REFERENCED FOR THE HARNESS ASSY.

1. APPLY A SMALL AMOUNT OF HEATSINK COMPOUND BETWEEN Q1 AND THE HEATSINK.

* 2. ARROWS INDICATE THE DIRECTION THE DIRECTION THE WIRES SHOULD BE WHEN HARNESSING.

* 3. TERMINAL E5 HAS 2 WIRES.

* 4. TERMINALS E10, E18, AND E19 HAVE NO WIRES.

* 5. WIRES FROM TERMINALS E1, E2 AND E3 SHOULD BE RUN IN THE DIRECTION THE ARROWS INDICATE, BUT SHOULD BE TIED SEPERATELY.

* 6. ALL WIRES SHOULD BE TIED SO THEY MEET AT POINT A. CONTINUE TYING THE WIRES FROM E1, E2, AND E3 FOR APPROXIMATELY 3 IN.. AT THIS POINT THE WIRE FROM TERMINAL E4 (THE SHORTEST BLACK WIRE) SHOULD BE LEFT FREE. CONTINUE TYING THE TWO REMAINING BUNDLES OF WIRES FOR APPROXIMATELY 7 IN.. WHILE DOING SO, RUN THE BUNDLES UNDER THE BOARD SO THAT THEY COME OUT AT THE CORNER OPPOSITE POINT A, THEN TIE BOTH BUNDLES TOGETHER WITH ONE TY-RAP.

7.

* 8. RED 20 AWG WIRE FROM E7 AND BLACK 20 AWG WIRE FROM E5 SHOULD BE LEFT OUT OF THE HARNESS.

9. LEADS ON CAPACITOR C1 MUST BE CUT TO A LENGTH OF 1/8". THE LEADS ARE TO BE BENT OVER AGAINST P.C. BD. IN LINE WITH TRACE BEFORE SOLDERING.

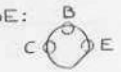
10. THE CORRECT LENGTH OF A COMPONENT LEAD AFTER THE COMPONENT HAS BEEN INSERTED INTO THE P.C. BD. WILL BE: NOMINALLY: .075
A MINIMUM OF: .05
A MAXIMUM OF: .10

11. ALL STAKED TERMINAL LUGS WILL BE SOLDERED AT THE FOIL SIDE OF THE BOARD.

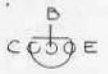
12. ASSEMBLE XSTR (ITEM 21) AND XSTR MTG PAD (ITEM 36) AS SHOWN IN DETAIL A. PROPERLY ORIENT PARTS AS SHOWN (Q3).

NOTE:
ALTERNATE TRANSISTOR BASING
2N4250 ONLY. TOP VIEW SHOWN:

OFFSET LEAD PACKAGE:



IN-LINE LEAD PACKAGE:



DETAIL A

MEDASONICS

SCALE: 2:1	APPROVED BY: J. Wolf	DRAWN BY:
DATE: 7-11-74		REV: V

P C ASSEMBLY, POWER SUPPLY, D8

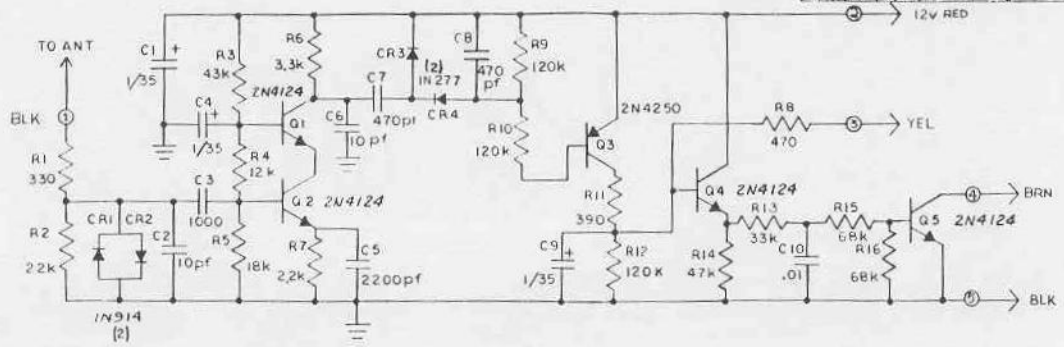
DRAWING NUMBER 109-0011-010

102-0006-XXX	D8
NEXT ASSY	USED ON
APPLICATION	

4549	H	REVISED PER DCO	3-30-92	[illegible]

(Figure 12)

REVISIONS				
ECO	LTR	DESCRIPTION	DATE	APPROVED
4	A	REPLACED FET SWITCH WITH BIPOLARS		KLB
		AND REDRAWN, S.N. H107.	3-27-75	JW
130	C	Q1,Q2,Q4 AND Q5 WERE GET, ARE GES	4-27-78	[illegible]
312	D	DOCUMENT NUMBER CHANGED	9-25-78	
3033	E	CHNG DIODES TO IN914	2-27-86	K. Bacho
3895	F	REVISED PER ECO	7-8-91	K. Bacho
3995	G	REVISED PER ECO	10-1-91	[illegible]



NOTES: (UNLESS SPECIFIED OTHERWISE)

1-ALL RESISTANCE VALUES IN OHMS 5% 1/4W

2-ALL CAPACITANCE VALUE IN MICROFARADS

LAST USED	NOT USED
R16	
C10	
CR4	
Q5	

109-0012-010	DB/OPT, 801
NEXT ASSY.	USED ON
APPLICATION	

MEDASONICS

SCALE:	APPROVED BY	DRAWN BY
DATE 4-2-75	[illegible] 5-7-75	REVISED

SCHEMATIC, ELECTROCAUTERY

REV H

DRAWING NUMBER 011-0012-010

(Figure 13)

NOTES (UNLESS OTHERWISE SPECIFIED):

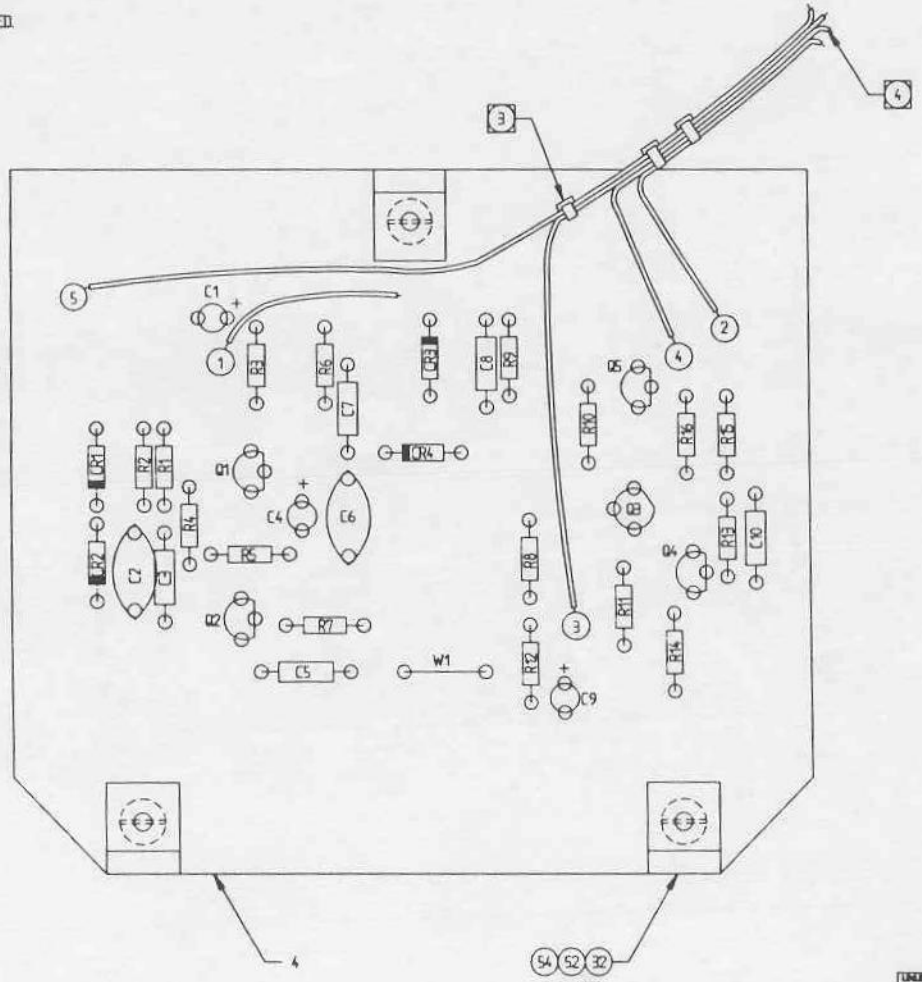
1 THE CORRECT LENGTH OF A COMPONENT LEAD AFTER THE COMPONENT HAS BEEN INSERTED INTO THE P.C. BD WILL BE:
NOMINALLY: .075
A MINIMUM OF: .05
A MAXIMUM OF: .10

2 ALL STAKED TERMINAL LUGS WILL BE SOLDERED AT THE FOIL SIDE OF THE P.C. BOARD.

(3) INSTALL TIE WRAPS AS REQUIRED.

(4) STRIP AND TIN 1/4"

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
4	A	CIRCUIT CHANGE	3/31/75	RM
130	B	REVISE Q1, 2, 4, 5	3/8/77	RM
215	C	2N4215 ALT. BASING	11/29/77	ARM
312	D	DOCUMENT NUMBER CHANGED	9/25/78	ARM
328	E	ADDED NOTE 1	1/2/79	ARM
361	F	ADDED NOTE 2	3/14/79	ARM
912	G	WIRE ASSY, ADDED BOM RETYPED	4/31/81	TW
1014	H	CHANGED PC TERMS WIRE LENGHT FROM 9" TO 8"	5/28/81	KLW
	J	NOTE 1 MAX .10 WAS .06 ECO 2393	9/26/83	SAKAI
2709	K	UPDATED BOM	10/30/84	L.CHANDLER
3033	L	BOM CHANGE	2/27/86	K.BACHCI
3895	M	REVISED PER ECO	7/8/91	K.BACHCI
3896	N	REVISED PER DCO	10/3/91	N.WILLIAMS
4522	P	REVISED PER DCO	9/3/92	N.WILLIAMS
4549	Q	REVISED PER DCO	9/30/92	N.WILLIAMS
	R	REVISED PER DCO# 4895	12/15/93	N.WILLIAMS
	S	REVISED PER DCO# 3140	4/21/95	



NOTE:
ALTERNATE TRANSISTOR BASING
2N4250 ONLY, TOP VIEW SHOWN:

OFFSET LEAD PACKAGE: B C E

IN-LINE LEAD PACKAGE: B C E

PC TERM	COLOR	SIZE	LENGHT
1	BLACK	20 GA.	18 IN.
2	RED	24 GA.	5 IN.
3	YELLOW	24 GA.	7 IN.
4	BROWN	24 GA.	5 IN.
5	BLACK	24 GA.	8 IN.

102-0023-010	DB/801
NEXT ASSY	USED ON
APPLICATION	DO NOT SCALE DRAWING

DRAWN NMH 1/4/93
CHECKED [illegible] 1/24/95
ENGR [illegible] 1/24/95
APPROVED [illegible] 1/24/95
CAD FILENAME P0179ADA.DWG

MEDASONICS

PC ASSEMBLY
ELECTROCAUTERY

SIZE B | DWG. NO. 109-0012-010 | REV. S
SCALE NTS | SHEET 1 OF 1

D8 WIRING LIST

TABLE 2

POWER SUPPLY

TERMINAL	DESTINATION
E1	Transformer Lug 7
E2	Transformer Lug 6
E3	Transformer Lug 5
E4	Ground Lug B
E5	Battery Pack "Negative"
E6	N/C (J5-4 Some Models)
E7	Battery Pack "Positive" via fuse
E8	J5-6
E9	S2a-Common 4
E11	S1
E12	Amplifier Terminal L
E13	S2b-Common 4
E14	S2b-3
E17	Amplifier Terminal P
All Others	No Connection N/C

AMPLIFIER

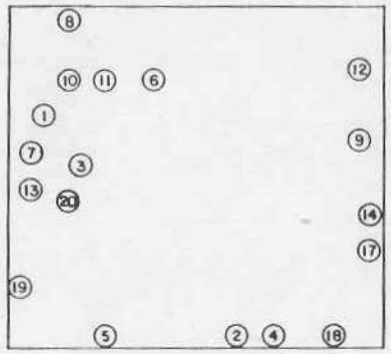
TERMINAL	DESTINATION
A	P2 Front Panel
B	P2 Front Panel
C	J5-1 Rear Panel
D	S3a-1
E	S3a-4
F	S3b-1,2
G	S3b-4
H	J5-4, J3-3
I	J6-Tip
J	J6-Contact
K	J5-3
L	Power Supply Terminal E12
M	Speaker
N	Speaker
P	Power Supply Terminal E17
R	J5-5, J3-5
U	J3-2, Ground
V	LED Front Panel
W	LED Front Panel
Y	J5-7, J2-5
All Others	N/C

ELECTROCAUTERY CUT-OUT
(OPTION 01)

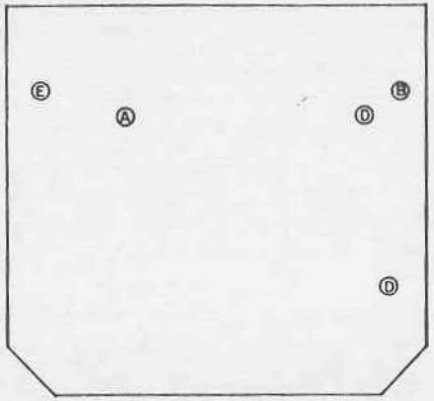
TERMINAL	DESTINATION
A	Antenna
B	Amplifier J2-4
C	Amplifier J2-5
D	Amplifier J2-2
E	Amplifier J2-3

(Figure 14)

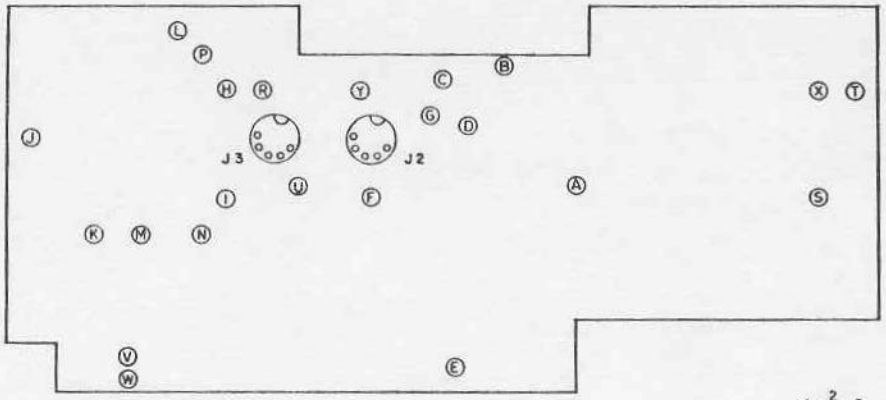
NOTES:(UNLESS SPECIFIED OTHERWISE)
1- ALL BOARDS SHOWN-COMPONENT SIDE



POWER SUPPLY



ELECTROCAUTERY



AMPLIFIER

J2 J3

S2 S3
REAR

MEDSONICS, INC.		
SCALE:	APPROVED BY:	DRAWN BY:
DATE: 5-22-75		REVISED
D8 TERMINAL DESIGNATION		
		DRAWING NUMBER

CHART RECORDER OUTPUT OPTION 03 (circuit diagram page 22)

The chart recorder output circuit is a frequency to voltage conversion circuit of the zero crossing type. The average value of the changing Doppler frequency is converted to a varying DC voltage for observation on a monitor oscilloscope or for permanent recording on a strip chart recorder.

There are two inputs available to this circuit; "filtered" and "unfiltered", selected by changing a soldered jumper wire on the PC board. The unit is normally supplied with a jumper for "unfiltered" operation. In the "filtered" position the rear panel tone control acts on the audio signal presented to the zero-crossing detector.

The audio signal is amplified by Q1 and fed to the Schmitt trigger circuit A1. The reference voltage for A1 is developed from the voltage divider R6 and R7. This reference voltage can be varied slightly by P1 which varies the sensitivity of the chart recorder circuit. The front panel volume control affects the overall signal and must be adjusted for satisfactory chart output signals. The output of A1 is then fed through a differentiator circuit C9, R14 where the positive spikes trigger monostable multivibrator Q2 and Q3. Transistor Q4 is used to speed up the charging of timing capacitor C10. Q5 shapes the output pulse and drives passive filter R19, R20 and C11. A 2 pole active filter (A2) follows, and the result is a varying DC voltage proportional to the average voltage of the pulse train from the monostable multivibrator.

There are three voltage outputs available from the chart recorder circuit. The low level output of 3 mv/KHz is typically used to feed directly into the patient input of a standard ECG machine. A high level output of 300 mv/KHz will drive some chart recorders. Most chart recorders have a high sensitivity input and will work with our medium level output of 15 mv/KHz. Trimmer P2 is used to calibrate the output levels. The desired output level can be changed by moving a plug-in jumper wire, therefore no soldering is necessary. The plug-in jacks are labeled on the back of the PC board, "HI", "M", and "LO". This corresponds to terminals F (HI), G (M), and H (LO) as shown on the PC board layout on page 23. *Option 03 is normally supplied wired for medium "M" output level.* NOTE: For best results a DC coupled chart recorder should be used. Baseline information is lost when the instrument is connected to the input leads of an ECG.

INSTALLATION

The chart recorder circuit board can be removed and installed in the same manner as the electrocautery board. See the photo on page 11.

TROUBLESHOOTING

For information that will aid in troubleshooting this circuit refer to the section above. The schematic on page 22 and the following calibration procedure will also be useful.

TABLE 3

CHART RECORDER OUTPUT TYPICAL DC POWER VOLTAGES

	E	B	C
Q1	2.49	3.05	7.36
Q2	0.0	0.0	5.16
Q3	0.0	.04	5.16
Q4	4.8	5.16	5.16
Q5	0.0	0.16	0.37

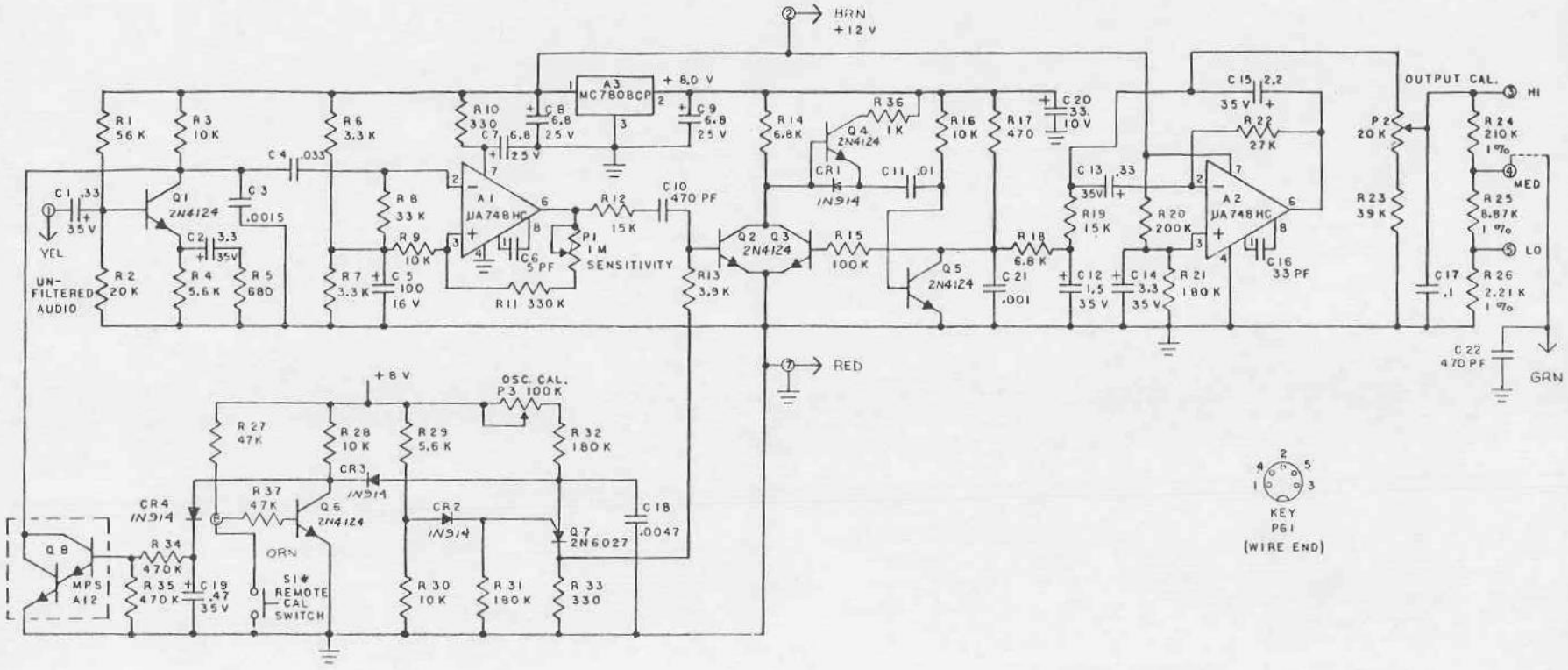
	1	2	3	4	5	6	7	8
A1	.057	6.09	6.04	0.0	1.38	1.19	10.41	0.63
A2	1.31	5.13	5.03	0.0	1.23	5.14	11.92	4.57

CHART RECORDER OUTPUT CALIBRATION

1. To calibrate the chart recorder circuit, first remove and unplug the printed circuit board from the VERSATONE. Attach a +12V DC power supply to Terminal "D" and the ground lead to Terminal "E". Attach an audio signal generator and oscilloscope to Terminal "B" with their grounds connected to Terminal "E".
2. Set the generator to 5 KHz ± 0.2% and turn its output to zero. Adjust P_2 on the circuit board, full cw and P_1 full ccw. Connect a high impedance DVM, to lug "F". Turn on the power supply and read the zero offset voltage (less than 20 mvDC).
3. Increase the generator output to the point where the voltage at Terminal "3" just stops varying, becoming stable at approximately 1V DC. The generator level at this point is the threshold voltage and should be approximately mvPP.
4. Next adjust P_2 if necessary so the voltage at Terminal "3" is 1.512V DC ± 10 mv. Reduce the power supply voltage to ± 10V DC. The output voltage should not vary more than 2.0%. Return the power supply to +12V DC and move the DVM to Terminal "4," the voltage should read +75.6 mvDC (±2%) and the voltage at "5" should read +15.12 (±2%) mvDC.
5. Return the DVM to Terminal "3" and vary the generator to 7.5 kHz, the voltage at Terminal "3" should be 2.262V DC ± 2.0%.
6. This completes the calibration of the chart recorder circuit.

To aid in troubleshooting the chart recorder, see a list of DC bias voltages above.

(Figure 15)



NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL RESISTOR VALUES ARE IN OHMS, ± 5 %, 1/4W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.
3. S1 NOT PART OF PC BOARD.

REFERENCE DESIGNATIONS

LAST USED	NOT USED
R 37	
C 22	
CR 4	
Q 8	
A 3	
P 3	
⑧	

ECO	LTR	DESCRIPTION	DATE	APPROVED
4547	K	REVISED PER DCO	9-25-92	A Wilson
3896	J	REVISED PER DCO	10-1-91	A Wilson
3033	H	CHNG CR1,2,3,4 TO IN914	2-27-86	V Bacho
312	G	DOCUMENT NUMBER CHANGED	9-25-78	
130	F	Q1,Q2,Q3,Q4,Q5 AND Q6 WERE GET, ARE GES	4-27-78	RJ
62	E	ADDED R37	10-4-76	R.W.
53	D	ADDED C20,C21,C22; CHANGED R 15	10-4-76	R.W.
		15K TO 100K		
27	C	ADDED CAL CKT & REDREW.	12-19-75	J.C.W.

REVISIONS

109-0013-010	08/OPT. 803
NEXT ASSY.	USED ON
APPLICATION	

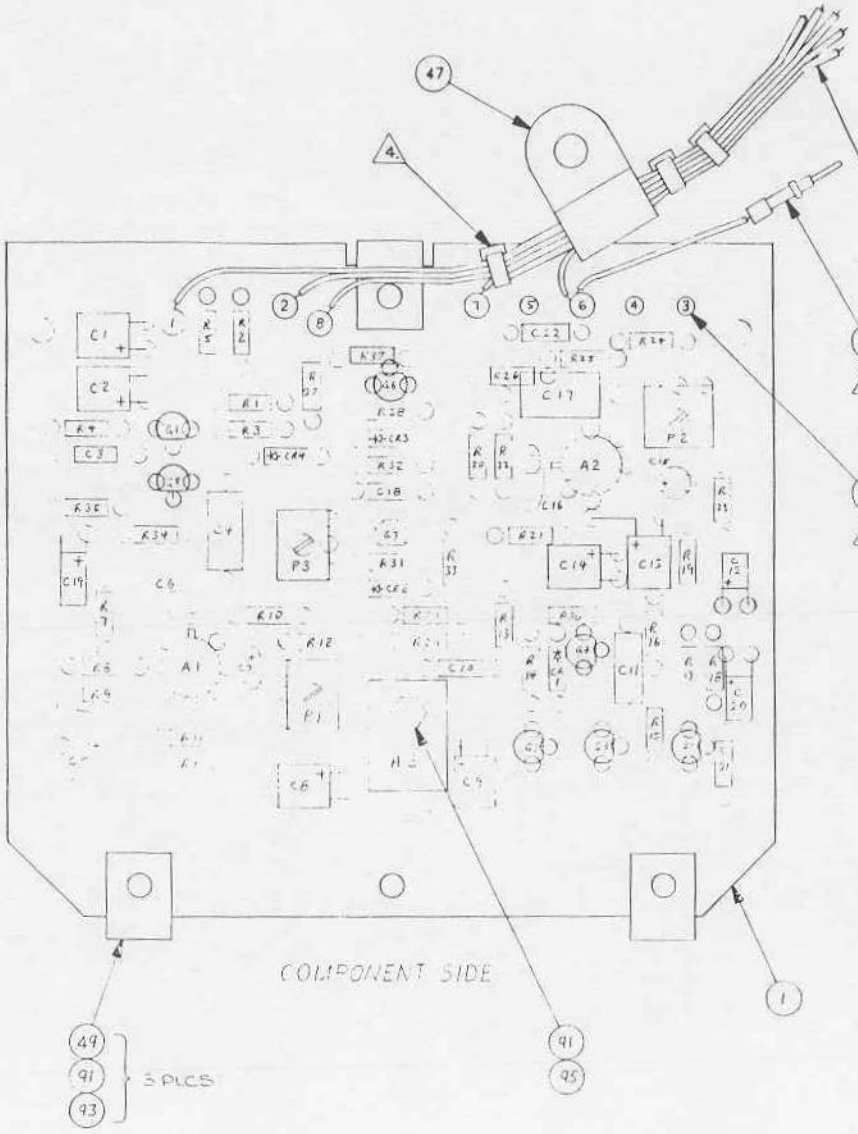
MEDASONICS

SCALE:	APPROVED BY:	DRAWN BY KAKUK
DATE: 12-19-75	B.W. JUKES	REVISED

SCHEMATIC, CHART RECORDER

DRAWING NUMBER 011-0013-01 REV K

(Figure 16)



REVISIONS				
ECO	REV	DESCRIPTION	DATE	APPROVED
23	A	ADDED CALIBRATION CKT & REDRAWN	10-16-75	
59	B	ADDED C20,21,22, R36	10-12-76	
62	B	ADDED R37	10-12-76	
180	C	REVISE Q1, 2, 3, 4, 5, 6	3-8-77	
312	D	DOCUMENT NUMBER CHANGED	9-25-78	
328	E	ADDED NOTE 1.	1-2-79	
361	F	ADDED NOTE 2	3-14-79	
903	G	ADDED NOTE'S 3 & 4, ALL WIRE CONNECTIONS, AND BUBBLE CALL OUTS.	4-23-81	
2709	H	UPDATED BOM		
3033	J	BOM CHANGE ECO 3033		
3896	K	REVISED PER DCO	10-1-91	
4547	L	REVISED PER DCO		

PC TERM	COLOR	SIZE	LENGTH
1	YELLOW	22 AG	2 IN.
2	BROWN	22 AG	7 IN.
3			
4			
5			
6	GREEN	22 AG	5 IN.
7	RED	22 AG	6 IN.
8	ORANGE	22 AG	4 IN.

NOTES:

1. THE CORRECT LENGTH OF A COMPONENT LEAD AFTER THE COMPONENT HAS BEEN INSERTED INTO THE P.C. BD. WILL BE: NOMINALLY: .075
   A MINIMUM OF: .05
   A MAXIMUM OF: .10
2. ALL STAKED TERMINAL LUGS WILL BE SOLDERED AT THE FOIL SIDE OF THE P.C. BD.
3. MALE PIN ITEM (41) CONNECTED TO PIN 6 THRU A 2" GREEN 22 AWG WIRE AND PLUGGED INTO FEMALE PIN 3.
4. INSTALL TIE WRAPS AS REQUIRED.
5. STRIP AND TIN 1/4"

102-0024-010	D8/B05
NEXT ASSY	USED ON
APPLICATION	

MEDASONICS

SCALE: 2:1	APPROVED BY: J. [illegible]	DRAWN BY: E. W.
DATE: 10-16-75		REVISED

P.C. ASSEMBLY, CHART RECORDER — REV L

DRAWING NUMBER 109-0015-010

TABLE 4

CHART RECORDER OUTPUT WIRING LIST (OPTION 03)

TERMINAL	DESTINATION
1	Amplifier J3-4
2	Amplifier J3-1
3	Terminal 6 for "HI" Output
4	Terminal 6 for "MED" Output
5	Terminal 6 for "LO" Output
6	Amplifier J3-5
7	Amplifier J3-2
8	Amplifier J3-3

TABLE 5

TABLE OF SUPPLIED EQUIPMENT

QUANTITY	DESCRIPTION
1	Versatone Model D8 Ultrasound Doppler.
1	5.3MHz, 2cm Square Probe (P84)
1	Detachable Power Cable, 7 Foot, 3-Wire grounded cord listed by UL and CSA.
1	60 Gram tube, Ultrasound Coupling Gel
1	Probe Holder
1	Operators Manual
1	Service Manual

TABLE 6

TABLE OF AVAIALABLE OPTIONAL EQUIPMENT

MODEL NUMBER	DESCRIPTION	MEDASONICS PART NUMBER
P81	2.4MHz, 3.3cm flat probe	101-0012-010
P82	8MHz, Pencil probe 6mm x 12cm	101-0013-010
P83	8MHz, Pencil Probe 6mm x 2.5cm	101-0014-010
P84	5.3MHz, 2cm square probe (8'Cable attached)	101-0015-010
SH3A	Stethoscope Style Headset	101-0008-010
Option 01	Electrocautery Sensory Cut-out	102-0023-010
Option 02	220 Volt Operation	N/A
Option 03	Chart Recorder Output Board	102-0024-010

D8 PARTS LIST

(Table 7)
CHASSIS

DRAWING REFERENCE	DESCRIPTION	MEDASONICS PART NUMBER
	Antenna	200-0026-010
	Antenna Clip	200-0027-010
	Battery Pack	103-0026-G10
	Connector, Power	150-0022-010
	Cover, Top	203-0025-010
	Cord, Power	106-0010-010
F1	Fuse .2A	151-0001-010
F1	Fuse .1A	151-0002-010
F2	Fuse 2A	151-0004-010
	Fuse Holder	200-0018-010
	Handle	200-0017-010
	Hinge	203-0035-010
LED-1	Indicator, Charging, Low Battery	214-0003-010
J-5	Jack, Auxiliary	150-0008-010
J-6	Jack, Headset	150-0033-010
J-4	Jack, Tape Recorder	150-0003-010
	Knob, Filter	200-0021-010
	Knob, On-Off, Volume	200-0020-010
	Panel, Front	203-0023-010
	Panel, Rear	203-0024-010
	Panel, Side (Handle)	203-0034-010
	Panel, Side (Speaker)	203-0033-010
	Potentiometer (Volume)	218-0015-010
	Red Button (For S1)	200-0001-010
	Rubber Foot (Bottom)	200-0135-010
	Rubber Foot (Side)	200-0006-010
S-1	Switch	243-0001-010
S-2, S-3	Switch	240-0002-010
	Speaker	200-0019-010
	Tray	203-0026-010

(Table 8)
AMPLIFIER

DRAWING REFERENCE	DESCRIPTION	MEDASONICS PART NUMBER
CR1,2,4,5,6,7	Diode, DA1704	111-0002-010
CR3	Diode, Zener 5.1V	111-0007-010
Q2	Transistor, GES3415, NPN	115-0002-010
Q1	Transistor, Select, 2N4250, NPN	115-0005-030
Q3	Transistor, 2N6027, PUT	115-0010-010
A3	IC, MC1458CPI	120-0001-010
A2	IC, LM380N	120-0008-010
A1	IC, 748 OP AMP	120-0014-010
C4	Cap, Tant, .047uf, 35V, 10%	128-0001-010
C8,11,20	Cap, Poly, .01uf, 100V, 10%	129-0001-010
C16	Cap, Poly, .047uf, 100V, 10%	129-0003-010
C12	Cap, Poly, 4700pf, 100V, 10%	129-0004-010
C17	Cap, Poly, .1uf, 100V, 10%	129-0005-010
C23,24	Cap, Poly, 1000pf, 10%	129-0006-010
C10,14	Cap, Poly, 6800pf, 100V, 10%	129-0007-010
C9	Cap, Poly, .033, 100V, 10%	129-0011-010
C2	Cap, Elec, 2200uf, 16V	130-0006-010
C19	Cap, Elec, 100uf, 16V	130-0009-010
C18	Cap, Elec, 330uf, 25V	130-0011-010
C22	Cap, Diptan, 33uf, 10V	131-0001-010
C7,13	Cap, Diptan, Selected, 1uf	131-0002-020
C5,21	Cap, Diptan, 6.8uf, 25V	131-0003-010
C6,25	Cap, Ceramic, 10pf, 1KV	133-0001-010
C1,3	Cap, Ceramic, 150pf, 1KV	133-0002-010
L1	Inductor, 1.5uh, 5%, Shld	146-0001-010
J1	Conn, Modified, 30 Pin	150-0006-020
J2,3	Conn, 5Pin, Fem, PC Mtg	150-0007-010
P1,3	Res, Var, 10K Ohm, PC Mtg	218-0006-010
R19	Res, CF, 2.7 Ohm, 5%, 1/4 W	230-3700-006
R6	Res, CF, 68 Ohm, 5%, 1/4 W	230-3700-038
R7,8,13	Res, CF, 330 Ohm, 5%, 1/4 W	230-3700-054
R26	Res, CF, 680 Ohm, 5%, 1/4 W	230-3700-062
R9	Res, CF, 2400 Ohm, 5%, 1/4 W	230-3700-075
R14	Res, CF, 2.7K Ohm, 5%, 1/4 W	230-3700-076
R18,22	Res, CF, 4.7K Ohm, 5%, 1/4 W	230-3700-082
R16	Res, CF, 6.8K Ohm, 5%, 1/4 W	230-3700-086
R15,17	Res, CF, 10K Ohm, 5%, 1/4 W	230-3700-090
R10,21,23	Res, CF, 15K Ohm, 5%, 1/4 W	230-3700-094
R20,28	Res, CF, 18K Ohm, 5%, 1/4 W	230-3700-096
R33,34	Res, CF, 22K Ohm, 5%, 1/4 W	230-3700-098
R24	Res, CF, 100K Ohm, 5%, 1/4 W	230-3700-114
R27	Res, CF, 120K Ohm, 5%, 1/4 W	230-3700-116
R11	Res, CF, 220K Ohm, 5%, 1/4 W	230-3700-122
R12	Res, CF, 240K Ohm, 5%, 1/4 W	230-3700-123
R29,30,31	Res, CF, 330K Ohm, 5%, 1/4 W	230-3700-126
R32	Res, CF, 1M Ohm, 5%, 1/4 W	230-3700-138
R25	Res, CC, 2.2M Ohm, 5%, 1/4 W	231-4500-153
R4	Res, MF, 1.87K Ohm, 1%, 1/4 W	232-5900-303
R25	Res, MF, 28.7K Ohm, 1%, 1/4 W	232-5900-531
R1	Res, MF, 47.5K Ohm, 1%, 1/4 W	232-5900-573
R3	Res, MF, 294K Ohm, 1%, 1/4 W	232-5900-725

(Table 9)
POWER SUPPLY

DRAWING REFERENCE	DESCRIPTION	MEDASONICS PART NUMBER
CR1,2,3,8	Diode, A14F	111-0001-010
CR5,6,7	Diode, Select, 1N270	111-0003-020
CR4	Diode, Ultra Fast, Sw, Hi Cond	111-0021-010
Q2	Transistor, GES3415, NPN	115-0002-010
Q5	Transistor, Select, 2N5088, NPN	115-0007-020
Q1,4	Transistor, D45C2	115-0013-010
Q6	Transistor, MPSA12, Darlington	115-0015-010
Q3	Transistor, 2N5355, PNP	115-0047-010
A1	IC, 776, Programmable Op Amp	120-0015-010
C3	Cap, Tant, Selected, 10uf	128-0007-030
C2	Cap, Poly, .01uf, 100V, 10%	129-0001-010
C5	Cap, Poly, .047, 100V, 10%	129-0003-010
C1	Cap, Elect, 3300uf, 16V	130-0005-010
J1	Conn, Pin, .040 Dia, Fem	150-0009-020
J2	Conn, Pin, .062 Dia, Fem	150-0010-020
P2	Res, Var, 100K Ohm, PC Mtg	218-0013-010
R3	Res, CF, 68 Ohm, 5%, 1/4 W	230-3700-038
R5	Res, CF, 910 Ohm, 5%, 1/4 W	230-3700-065
R1,11,12	Res, CF, 2.2K Ohm, 5%, 1/4 W	230-3700-074
R4	Res, CF, 2.7K Ohm, 5%, 1/4 W	230-3700-076
R10	Res, CF, 10K Ohm, 5%, 1/4 W	230-3700-090
R6,7	Res, CF, 47K Ohm, 5%, 1/4 W	230-3700-106
R8,31	Res, CF, 120K Ohm, 5%, 1/4 W	230-3700-116
R24	Res, CF, 200K Ohm, 5%, 1/4 W	230-3700-121
R22	Res, CF, 270K Ohm, 5%, 1/4 W	230-3700-124
R9,13	Res, CF, 470K Ohm, 5%, 1/4 W	230-3700-130
R21	Res, CF, 820K Ohm, 5%, 1/4 W	230-3700-136
R14	Res, CF, 1M Ohm, 5%, 1/4 W	230-3700-138
R33	Res, CF, 1.3M Ohm, 5%, 1/4 W	230-3700-141
R23	Res, CF, 1.5M Ohm, 5%, 1/4 W	230-3700-142
R17	Res, CF, 2.7M Ohm, 5%, 1/4 W	230-3700-148
R19	Res, CF, 3.3M Ohm, 5%, 1/4 W	230-3700-150
R15,16	Res, CF, 4.7M Ohm, 5%, 1/4 W	230-3700-154
R18	Res, CC, 10M Ohm, 5%, 1/4 W	231-4500-169
R20	Res, MC, 22M Ohm, 5%	231-4500-177
R2	Res, CF, 6.8 Ohm, 5%, 1/2 W	234-3900-014
R32	Res, CF, 1500 Ohm, 5%, 1/2 W	234-3900-070

TABLE 10

01 OPTION

DRAWING REFERENCE	DESCRIPTION	MEDASONICS PART NUMBER
CR3,4	Diode, Select, 1N270	111-0003-020
CR1,2	Diode, Ultra Fast Sw, Hi Cond	111-0021-010
Q1,2,4,5	Transistor, GES3415, NPN	115-0002-010
Q3	Transistor, Select, 2N4250, PNP	115-0005-020
C10	Cap, Poly, .01uf, 80V, 10%	127-0001-010
C5	Cap, Poly, 2200pf, 200V, 10%	127-0002-010
C3	Cap, Poly, 1000pf, 200V, 10%	127-0003-010
C7,8	Cap, Poly, 470pf, 200V, 10%	127-0013-010
C1,4,9	Cap, Diptan, Select, 1uf	131-0002-020
C2,6	Cap, Ceramic, 10pf, 1KV	133-0001-010
PG1	Conn, 5 pin, Male	150-0023-010
R1	Res, CF, 330 Ohm, 5%, 1/4 W	230-3700-054
R11	Res, CF, 390 Ohm, 5%, 1/4 W	230-3700-056
R8	Res, CF, 470 Ohm, 5%, 1/4 W	230-3700-058
R7	Res, CF, 2.2K Ohm, 5%, 1/4 W	230-3700-074
R6	Res, CF, 3.3K Ohm, 5%, 1/4 W	230-3700-078
R4	Res, CF, 12K Ohm, 5%, 1/4 W	230-3700-092
R5	Res, CF, 18K Ohm, 5%, 1/4 W	230-3700-096
R2	Res, CF, 22K Ohm, 5%, 1/4 W	230-3700-098
R13	Res, CF, 33K Ohm, 5%, 1/4 W	230-3700-102
R3	Res, CF, 43K Ohm, 5%, 1/4 W	230-3700-105
R14	Res, CF, 47K Ohm, 5%, 1/4 W	230-3700-106
R15,16	Res, CF, 68K Ohm, 5%, 1/4 W	230-3700-110
R9,10,12	Res, CF, 120K Ohm, 5%, 1/4 W	230-3700-116

TABLE 11

03 OPTION

DRAWING REFERENCE	DESCRIPTION	MEDASONICS PART NUMBER
CR1,2,3,4	Diode, Ultra Fast Sw, Hi Cond	111-0021-010
Q11,2,3,4,5,6	Transistor, GES3415, NPN	115-0002-010
Q7	Transistor, 2N6027, PUT	115-0010-010
Q8	Transistor, MPSA12, Darlington	115-0015-010
A1,2	IC, 748 OP Amp	120-0014-010
A3	IC, MC7808CP	120-0016-010
C11	Cap, Poly, .01uf, 80V, 10%	127-0001-010
C21	Cap, Poly, 1000pf, 200V, 10%	120-0003-010
C3	Cap, 1500pf, 200V, 10%	127-0005-010
C17	Cap, Poly, .1uf, 80V, 10%	127-0008-010
C4	Cap, Poly, .033uf, 80V, 10%	127-0009-010
C10,22	Cap, Poly, 470pf, 200V, 10%	127-0013-010
C18	Cap, Poly, 4700pf, 80V, 10%	127-0015-010
C19	Cap, Tant, .47uf, 35V, 20%	128-0003-010
C12	Cap, Tant, 1.5uf, 35V, 20%	128-0004-010
C1,13	Cap, Tant, .33uf, 35V, 10%	128-0005-010
C15	Cap, Tant, 2.2uf, 35V, 10%	128-0008-010
C2,14	Cap, Tant, 3.3uf, 35V, 10%	128-0009-010
C5	Cap, Elect, 100uf, 16V	130-0009-010
C20	Cap, Diptan, 33uf, 10V	131-0001-010
C7,8,9	Cap, Diptan, Selected, 6.8uf	131-0003-020
C16	Cap, Dipmica, 33pf, 500V, 5%	132-0002-010
C6	Cap, Dipmica, 5pf, 500V	132-0006-010
P2	Res, Var, 20K Ohm, PC MTG	218-0010-010
P3	Res, Var, 100K Ohm, PC MTG	218-0013-010
P1	Res, Var, 1M Ohm, PC MTG	218-0018-010
R10,33	Res, CF, 330 Ohm, 5%, 1/4 W	230-3700-054
R17	Res, CF, 470 Ohm, 5%, 1/4 W	230-3700-058
R5	Res, CF, 680 Ohm, 5%, 1/4 W	230-3700-062
R36	Res, CF, 1000 Ohm, 5%, 1/4 W	230-3700-066
R6,7	Res, CF, 3.3K Ohm, 5%, 1/4 W	230-3700-078
R13	Res, CF, 3900 Ohm, 5%, 1/4 W	230-3700-080
R4,29	Res, CF, 5.6K Ohm, 5%, 1/4 W	230-3700-084
R14,18	Res, CF, 6.8K Ohm, 5%, 1/4 W	230-3700-086
R3,9,16, 28,30	Res, CF, 10K Ohm, 5%, 1/4 W	230-3700-090
R12,19	Res, CF, 15K Ohm, 5%, 1/4 W	230-3700-094
R2	Res, CF, 20K Ohm, 5%, 1/4 W	230-3700-097
R22	Res, CF, 27K Ohm, 5%, 1/4 W	230-3700-100
R8	Res, CF, 33K Ohm, 5%, 1/4 W	230-3700-102
R23	Res, CF, 39K Ohm, 5%, 1/4 W	230-3700-104
R27,37	Res, CF, 47K Ohm, 5%, 1/4 W	230-3700-106
R1	Res, CF, 100K Ohm, 5%, 1/4 W	230-3700-108
R15	Res, CF, 100K Ohm, 5%, 1/4 W	230-3700-114
R21,31,32	Res, CF, 200K Ohm, 5%, 1/4 W	230-3700-120
R20	Res, CF, 200K Ohm, 5%, 1/4 W	230-3700-121
R11	Res, CF, 330K Ohm, 5%, 1/4 W	230-3700-126
R34,35	Res, CF, 470K Ohm, 5%, 1/4 W	230-3700-130
R26	Res, MF, 2.21K Ohm, 1%, 1/4 W	232-5900-317
R25	Res, MF, 8.87K Ohm, 1%, 1/4 W	232-5900-433
R24	Res, MF, 210K Ohm, 1%, 1/4 W	233-5900-697

TABLE OF SPECIFICATIONS

DESCRIPTION — A portable Doppler ultrasound unit with built-in loudspeaker and the facility to accept a variety of specially designed plug-in probes.

CABINET — A rugged metal chassis with ABS plastic side panels, a carrying handle, and provision for probe and accessory storage under a hinged top cover.

POWER SUPPLY — An internal rechargable nickel-cadmium battery pack provides 16 to 24 hours of service. Battery pack can be recharged in 8-12 hours. Unit can be operated while the battery is being charged.

LINE VOLTAGE RANGE — 105 to 130 volts. A 220 volt option is available. See page 29 for instructions to modify voltage to 220VAC.

ELECTRICAL SAFETY — All probes are electrically insulated from the operator and patient. There are no exposed crystals or delicate wires. Transformer leakage (115 volt operation) is less than 15 microamps. Underwriters Laboratory listed per UL544 for medical and dental equipment.

POWER CABLE — A 7 foot long, detachable, 3-wire grounded cord listed by UL and CSA.

PROBE RECEPTACLE— Compatible probes P-81, P-82, P-83, and P-84 plug in easily and are held securely by receptacle.

MAIN SWITCH — A three position switch provides a TIMED-ON position with a duration of approximately one minute, in addition to ON and STANDBY modes.

VOLUME CONTROL — A control for adjusting the level of Doppler shifted ultrasound output.

TONE CONTROL — A three position switch for selecting HIGH, LOW and NORMAL frequencies.

HEADSET JACK — Accepts a 1000 or 2000 ohm headset which automatically shuts off the loudspeaker for private listening.

TAPE RECORDER JACK — Tape recordings can be made by connecting a suitable cable from this jack to most tape recorders.

WEIGHT — 4 kilograms (8 pounds, 12 ounces)

SIZE — 25.5 cm wide, 25.5 cm deep, 12.7 cm high (10 inches x 10 inches x 5 inches)

TOOLS and TEST EQUIPMENT REQUIRED FOR SERVICE and REPAIR

TEST EQUIPMENT

Digital Multimeter	capable of measuring voltages down to 0.001V and resistance down to 0.1 Ohm and mA up to 200mA.
Oscilloscope	General purpose.
Variable Voltage Power Supply	Capable of delivering 0 to 20V dc at up to 500mA.
Leakage tester	Capable of detecting transformer leakage below 12 microamps.

TOOLS

Minimum tools required to service and repair the D8 Doppler

1 Small Phillips Screwdriver
1 Medium Phillips Screwdriver
1 Needlenose Pliers
1 Small Diagonal Cutters
1 35 Watt Soldering Iron with small grounded tip
1 Desoldering Tool (Solder sucker)
1 Set assorted Nut Drivers
1 Roll of Solder
1 Wire Stripper

PREVENTATIVE MAINTENANCE

Listed below is the recommended preventive maintenance program for the Model D8:

Perform at six month intervals:

(A) INSPECT

1. The power cord – for wear or damage.
2. Probe wires – for wear or damage.
3. Probe transducer – for cracks, chips or damage to the faceplate area.
4. Probe PC fingers – for contamination or damage. Clean carefully with solvent if necessary.
5. D8 VERSATONE – for signs of spilled liquids, case damage, control function, loose knobs, etc.

(B) TEST

1. Ground connection of power cord – for resistance of less than 0.1 ohm to chassis ground.
2. D8 and probe – Test using a healthy subject. Compare probe to a known good working one.
3. Both headset jacks – Test using a Medasonics SH3A headset or equivalent headset with an impedance of 2000 ohms.

Perform every two years:

1. Perform all steps listed above.
2. Cycle the battery pack – Charge the battery pack for 12 hours. Disconnect the power cord, turn the D8 on (unplug probe) and leave D8 on for 7 hours. At approximately 7 hours the "low battery" indicator should come on and shortly after that the D8 will completely shut off. Plug in the power cord and recharge the battery pack.
3. If electrocautery option is installed – Test the sensitivity as shown in the troubleshooting section of this manual.
4. Power supply calibration – Perform testing of power supply calibration as outlined in the troubleshooting section of this manual.
5. Amplifier calibration – Perform testing of amplifier calibration as outlined in the troubleshooting section of this manual.

STORAGE OF THE MEDASONICS MODEL D8

INDOOR and OUTDOOR STORAGE

The D8 should be packaged in an airtight vapor barrier with a small packet of a drying agent such as silica gel.

Store in an area where the ambient temperature does not exceed the range from 35 deg. F to 100 deg. F.

In the case of long term storage (6 months or more) provision must be made for inspection and testing of the unit every six months.

Each 6 months perform ALL preventive maintenance steps outlined in the PREVENTATIVE MAINTENANCE section of the SERVICE MANUAL.

The main consideration for storage is the regular testing and cycling of the battery pack at 6 month intervals. Battery packs which fail the cycling test should be replaced.

UNPACKING INSTRUCTIONS

1) Carefully open the shipping carton and remove the foam packing. Carefully remove the unit from the carton.

2) Remove the plastic wrapping from the equipment, saving the INSTRUCTIONS and the SERVICE MANUAL for future reference.

3) Inspect the unit for physical damage.

INITIAL ADJUSTMENTS and POWER REQUIREMENTS

No initial adjustments are necessary.

The unit contains a nickel-cadmium battery pack which will need to be charged initially overnight.

Connect the power cord found under the hinged top cover to the Power Connector on the rear panel of the unit.

Connect the plug end of the power cord to a 120 volt 60Hz Hospital Grade power outlet capable of delivering at least 1 amp.

For 220 volt option connect the plug end of the power cord to a 220 volt 50#3 hospital grade power outlet.

Observe that the Battery Charging Indicator on the back panel is on, indicating that the unit is charging.

After the initial charging is compete the unit is ready to use.

UNIT LOCATION

The unit should be located on a stable surface convenient to the patient being tested.

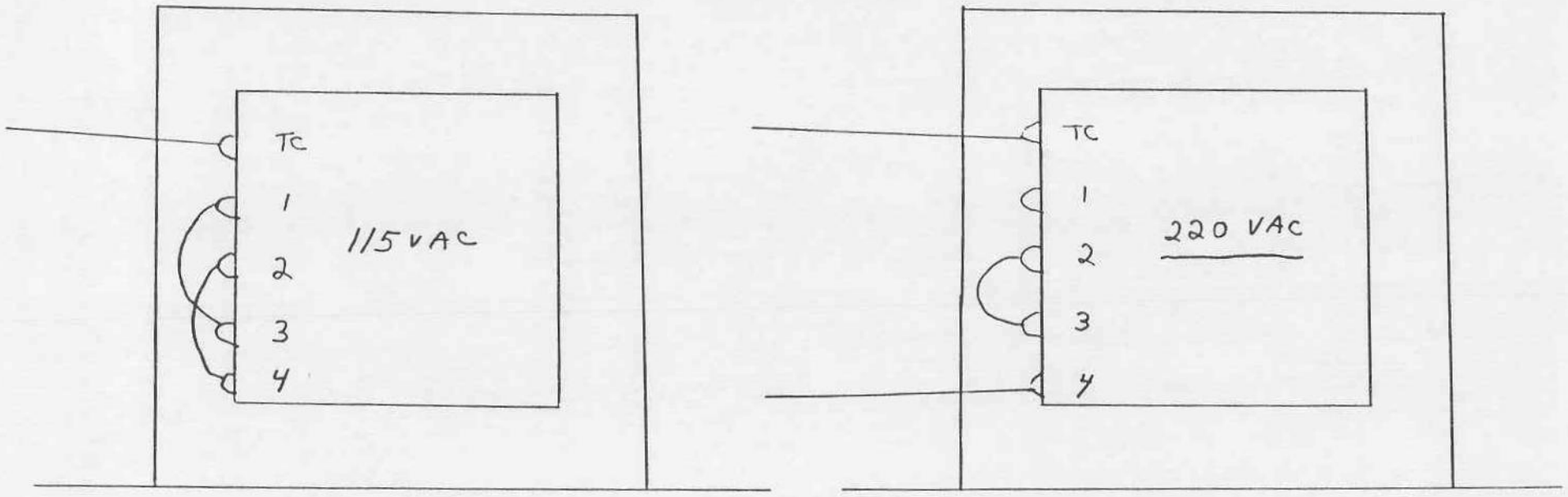
— WARNING —

UNDER NO CIRCUMSTANCES SHOULD THIS UNIT BE USED IN THE PRESENCE OF EXPLOSIVE ANESTHETICS.
The unit is not gas-tight and thus not explosion proof.

220 VAC CONVERSION PROCEDURE

1. Lift top cover.
2. Remove screws from black storage tray.
3. Carefully pry tray up (held down by RTV). Do not remove RTV!
4. Remove 4-40 screws located at the base of the top cover (inside). The cover and hinge can now be removed from the chassis. (D8, D9 have 5 Phillips screws on the outside.)
5. Disconnect + battery lead.
6. Remove rear panels.
7. Change jumpers on transformer as follows (refer to Fig. 30.1):
   a. Unsolder jumper at terminal 1. (Leave terminal 3 in place.)
   b. Unsolder jumper at terminal 2.
   c. Carefully cut jumper terminal 4. (Do not cut long wire.)
   d. Slip a 1/4" length of heat shrink tubing over the jumper still connected to terminal #3.
   e. Solder the jumper from terminal 3 to terminal 2. Slip the tubing over the terminal and shrink.
   f. Terminal 1 should be cleaned of excess solder and insulated with a small piece of shrink tubing.
8. Remove 2/10 power fuse(s) from fuseholder 151-0001-01.
9. Replace with 1/10A 151-0002-01.
10. Carefully replace the rear panel. Check for pinched wires.
11. Reconnect the + lead of the battery pack.
12. Carefully apply 220V 212-0020-01 label over the 115V markings on the rear panel.
13. Plug line cord into 220 VAC to be sure battery charging LED lights.
14. Replace top cover, be sure that it does not drag on the plastic side panels.

LINE VOLTAGE DRAWING
(Figure 17)



INSTRUCTIONS

Please read before using instrument

MEDASONICS

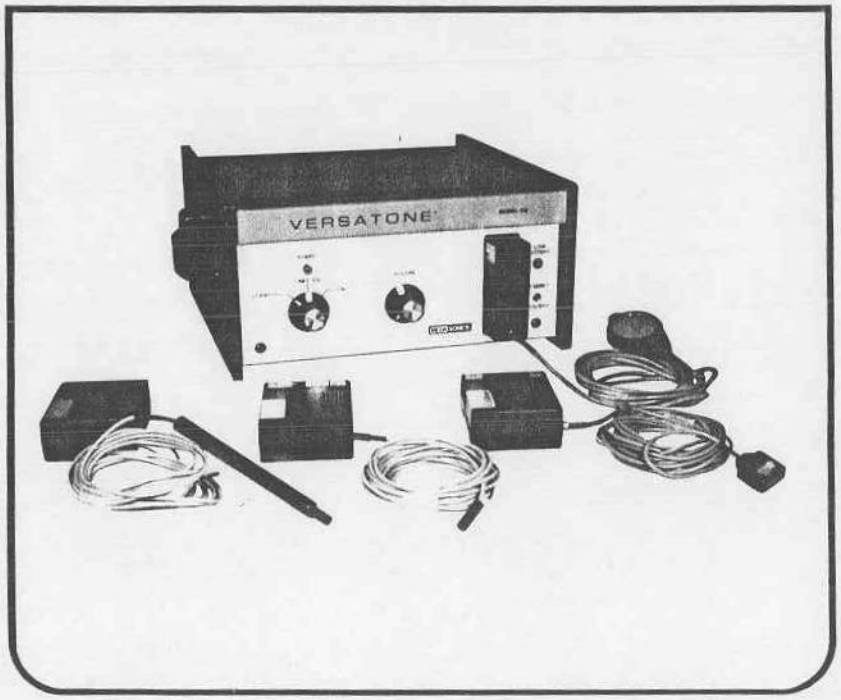
Fremont, California 94539

VERSATONE

DOPPLER MODEL D8

LISTED UL 1781

MULTIPURPOSE DOPPLER ULTRASOUND INSTRUMENT FEATURING INTERCHANGEABLE PROBES



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Clinical Use of Probes	36
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Versatone D8
(Figure 18)

INTRODUCTION

The MedaSonics VERSATONE® Doppler is the central unit of a versatile ultrasound system, designed to detect blood flow and other motion within the body. Four interchangeable plug-in probes of various configurations and frequencies are available for use with this central unit. VERSATONE, therefore, has a wide range of clinical applications. It may be used to take systolic blood pressure in infants and patients in shock, to detect air emboli in the venous system during neurosurgical procedures, and to detect blood flow transcutaneously in peripheral vessels before, during, and after surgery.

DOPPLER PRINCIPLE

Operation of the MedaSonics VERSATONE is based on the Doppler effect. This effect is named after its discoverer, Christian Doppler. In 1842, he theorized that the frequency of either light or sound, when emitted or reflected from a moving object, varies in proportion to the velocity of the object relative to the observer. An example of the Doppler effect is the noticeable change in pitch (frequency) of the sound made by a high speed car or aircraft as it passes by.

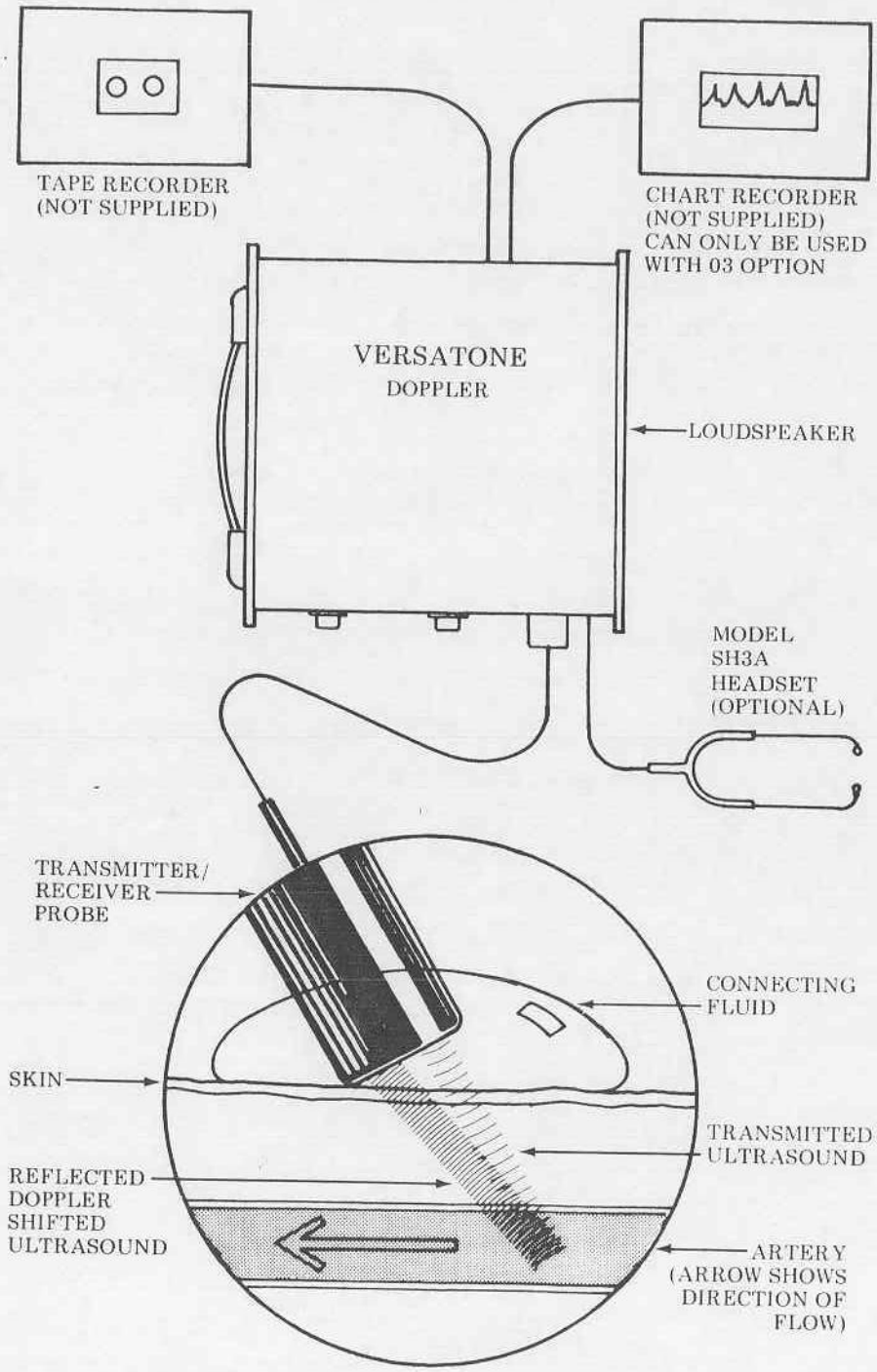
APPLYING ULTRASOUND AND THE DOPPLER PRINCIPLE

The diagram on the opposite page illustrates how ultrasound and the Doppler effect are applied in the VERSATONE to detect blood flow and other motion within the body.

A low power electrical signal is applied to a piezoelectric crystal transducer located in the probe tip. In response to the electrical signal the transducer vibrates; these vibrations produce low-energy, ultrahigh frequency sound (ultrasound), which is inaudible to the human ear. This ultrasound is emitted in the form of a beam; like the beam of a flashlight.

Because ultrasound will not travel through air, a connecting fluid or gel must be used to couple the probe to the body. Once in the body the ultrasound passes easily through the soft tissue. However, when it reaches a boundary between dissimilar tissues or structures, a portion of the ultrasound is reflected back to the transducer in the probe. If the reflective structure is moving the frequency of the reflected ultrasound is shifted. The shift is proportional to the velocity of the moving structure. This reflected, Doppler-shifted ultrasound causes the transducer to vibrate and thereby generate electrical signals. These signals are electronically processed and amplified in the VERSATONE and finally presented to the operator as audible sound with frequencies proportional to the reflective structure's velocity.

In the diagram the changing frequency of the sound corresponds to the changing velocity of cells in the arterial blood stream and therefore represents blood flow. The Doppler shift is also dependent on the angular relation of the probe and the blood flow. As the diagram indicates the VERSATONE presents the signal in a variety of ways so it can be listened to directly, tape recorded, or (with optional circuitry) recorded graphically.

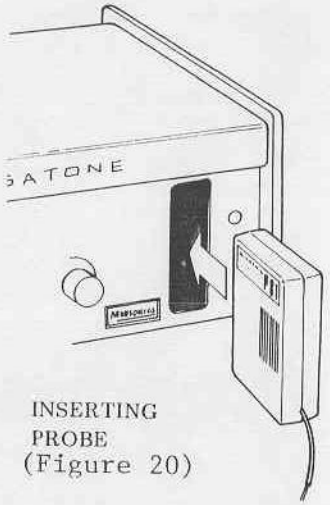


ENLARGED VIEW OF PROBE TIP
(Figure 19)

OPERATING INSTRUCTIONS

While following these operating instructions please refer to the illustrated description of the VERSATONE unit on pages 8 and 9.

1. Unpack the VERSATONE unit and place it in a convenient location.
2. Select one of the probes specifically designed for use with the Model D8 VERSATONE unit: These are the Model P81 (2.4 MHz) non-directional probe, Models P82/P83 (8 MHz) non-directional probes, and the Model P84 (5.3 MHz) non-directional probe. CAUTION: THE ATTEMPTED USE OF ANY PROBE OTHER THAN THE MedaSonics PROBES LISTED ABOVE COULD POSSIBLY CREATE A SHOCK HAZARD. Plug the probe into the probe receptacle on the front panel of the VERSATONE as shown in the illustration. Note that the probe lead wire is at the bottom of the probe plug unit. If properly aligned, the probe plug unit should fit snugly and securely.
3. Turn the front panel switch to the ON position. (The TIMED-ON position is explained later.) This supplies power from the internal battery pack, or through the battery pack from line voltage, if the power cable is connected. NOTE THAT VERSATONE IS NOT GAS TIGHT. IT SHOULD NOT BE USED IN THE PRESENCE OF EXPLOSIVE ANESTHETICS.
4. All VERSATONE Model D8 instruments are provided with shielding that effectively eliminates most radio-frequency interference. Radio-frequency interference introduced by electrocautery equipment is eliminated when the Model D8 is used with P81 probes, but not with P82, P83, or P84 probes. To obtain maximum freedom from electrocautery radio frequency interference, it is necessary to operate the VERSATONE on the battery power system. The power cord should be completely disconnected from the instrument. It may be placed in the top storage compartment of the D8.



INSERTING
PROBE
(Figure 20)

NOTE: The Verstone should be operated under battery power during intraoperative procedures to ensure safety from electrical hazards.

5. With power on, you are now ready to listen to heart or blood flow Doppler sounds.

   A. Adjust volume control as desired beginning with a low setting.

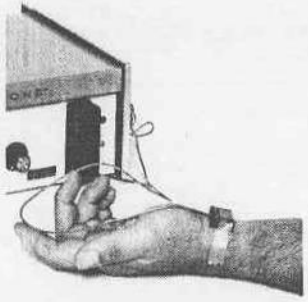
   B. A liquid coupling gel is essential for proper operation because ultrasound will not travel through air. Therefore, transcutaneous applications require that a generous amount of gel be applied to the body surface at the examination site. Because body hair can trap air, it should be thoroughly saturated with coupling gel when present at the examination site.

   C. Do not apply excessive pressure to the probe. When sufficient coupling gel is used, a light touch will produce the best results. Too much pressure can close off the vessel and give an indication of no flow.

   D. The ultrasound is emitted from the probes as a directional beam much like that of a flashlight. Visualizing this directional beam is useful when manipulating the probes to obtain the location and angle that provides the optimum signal.

   E. If you are using probe P81, apply a generous quantity of the coupling gel to the face of the probe (the silver disc), and press it against the chest over the heart. You should hear the distinctive, rhythmic Doppler sound corresponding to the heartbeat. As you move the probe over the area, you will generate noise; however, the meaningful sounds are quite distinctive and are surprisingly easy to recognize.

   F. If you are using probe P82 or P83, apply a quantity of transmission gel on the wrist over the radial or ulnar arteries. Touch the site lightly with the probe tip. Move the probe slowly



PROBE P84
(Figure 21)

while adjusting the angle until you hear the distinctive pulsing Doppler sound that indicates arterial blood flow.

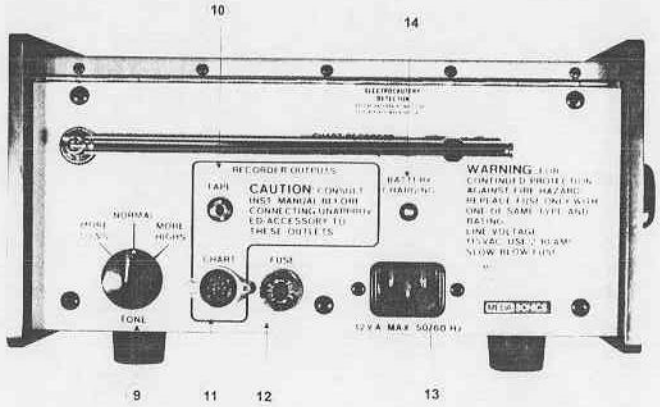
G. If you are using probe P84, apply a generous quantity of transmission gel to the recessed transducer face and the site of an artery on the wrist or arm. Move the probe slowly until you hear the distinctive pulsing Doppler sound that indicates arterial blood flow.

6. Sensitivity should be verified whenever Doppler signals are absent. In the event of any difficulty, a quick check can be made by listening to one's own heart or peripheral vascular sounds to verify sensitivity. Also check to see that the front panel switch is on the *ON* position, that the volume control is turned up, and that the probe is properly seated in the receptacle. Pull the probe plug-in housing out and reinsert it into the receptacle. Be sure the battery is charged (or charging), the faceplate area of the probe is free of residue, and that enough coupling gel is being used. Note that plugging a headset into the headset jack cuts off the loudspeaker. Finally, check the fuse on the back of the instrument. The fuse is removed by pushing the knob in while turning it counter-clockwise.

7. While listening to a Doppler sound, adjust the tone control located on the back panel of the VERSATONE unit. The *MORE LOWS* setting tends to reduce noise, while the *MORE HIGHS* position minimizes interference from probe motion, artifacts, or low frequency signals. For most applications the *NORMAL* setting will give the best results.

8. To operate the system in the *TIMED-ON* mode, turn the front panel switch to the *TIMED-ON* position and press the red start button. The instrument will remain on for about one minute, then automatically switch off. Simply push the start button again to recycle the system for another minute.

FRONT PANEL
(Figure 22)



REAR PANEL
(Figure 23)

9. Up to this point you have been listening to the built-in loudspeaker. Should you wish to listen in private, MedaSonics Model SH3A headset is available as an accessory, and may be plugged into the headset jack on the front panel.

10. To make tape recordings of the Doppler sounds use MedaSonics HW1069 cable, which is available as an accessory, to connect the rear panel output jack to a suitable tape recorder. CAUTION: CONNECTION OF THE TAPE RECORDER OUTPUT JACK TO AN IMPROPERLY DESIGNED OR FAULTY TAPE RECORDER CAN RESULT IN SHOCK HAZARD.

ILLUSTRATED DESCRIPTION

FRONT PANEL(Figure 22)

1. Main Switch: Three positions—*ON*, *STAND BY* and *TIMED-ON*.
2. Start Button: Push to start timed operation when front panel switch is in *TIMED-ON* mode.
3. Volume Control: Controls the level of the sound from the loudspeaker or headset.
4. Probe Receptacle: Probe units are designed to plug into this receptacle.
5. Headset Jack: MedaSonics headset Model SH3A may be plugged into this jack for private listening.
6. Loudspeaker: Operates whenever the instrument is turned on, except when a headset is plugged in.
7. Low Battery Indicator: When the battery pack has been nearly exhausted, the low battery indicator light comes on and a beeping sound is generated.
8. Storage Space Cover: Lift cover for access to space for storing the power cable, probes, and small accessories.

REAR PANEL (Figure 23)

9. Tone Control: Three positions—*MORE LOWS*, *NORMAL* and *MORE HIGHS*. The *NORMAL* position should usually be selected.
10. Tape Recorder Output: Tape recordings of Doppler sounds may be made with most recorders. Use HW1069 cable.

11. Chart Recorder Output Connector: Provides output signal for chart recording on those instruments fitted with Option 03.
12. 2/10 Slow-Blow Fuse: (3AG) (Specially labeled 220 volt units use 1/10 amp slow-blow fuse.)
13. Power Cable Receptacle: A detachable 7-foot, 3-wire grounded cable with hospital grade connector is provided with the VERSATONE. The battery is charging whenever this cable is connected to a power source.
14. Battery Charging Indicator: This light is on whenever the battery pack is receiving a charge.

CARE AND SERVICE

1. When procedures using the VERSATONE® system are completed, turn the front panel switch to the *STANDBY* position (switch may be left in the *TIMED-ON* position). CAUTION: Disconnect AC power cord before attempting any service.
2. The faceplate area of each probe should be wiped clean with a damp cloth or cotton swab after each use. A soap solution may be used. DO NOT use alcohol or other solvents, DO NOT immerse any part of the VERSATONE system in liquids. DO NOT autoclave any part of the VERSATONE system.
3. The probe may be left plugged into the VERSATONE unit. Store the probe tip and the bulk of the cable under the storage space cover.
4. To assure that the internal nickel-cadmium battery pack is fully charged for portable use, it should be recharged overnight. To recharge, simply connect the power cable to the VERSATONE unit (power cable receptacle on rear panel), and plug into a 110-120 volt grounded receptacle. The power cable may be left plugged in continuously without damaging the equipment. If the battery is charging properly, the battery charging indicator light will glow. VERSATONE operates 16-24 hours on its battery pack, or continuously from line current.
5. A low battery is indicated when the low battery indicator light comes on and a beeping sound is heard. When further discharged, the instrument "cuts-out" and the battery indicator light does not function continuously.
6. You cannot harm the battery by operating the instrument to the "cut-out" point; in fact, the battery pack should be completely discharged at least once every six months to insure maximum efficiency.
7. It is recommended that regular checks of the power cord and instrument ground be made by qualified personnel. It is also recommended that plug-in probes be checked at regular intervals to insure that cables and insulation remain serviceable.

STORING PROBE
(Figure 24)

8. ELECTROCAUTERY SENSOR CUT-OUT. Certain electrocautery machines commonly used in operating rooms generate radio signals which when picked up by Doppler instruments produce loud, annoying sounds. The sensor consists of an antenna and circuitry which senses and then suppresses these annoying signals. Operating instructions for this option are included with your instrument. The sensor should not be needed with shielded P81 probe when operated on the battery power system if the power cord has been removed. It may be required when probes other than the P81 are used in close proximity to electrocautery equipment or when the P81 probe is used while the unit is being operated from external electrical power lines.
9. MedaSonics, Inc. maintains service facilities with the capability to promptly repair the VERSATONE Doppler. In the event of any service or maintenance problem, telephone the MedaSonics Service Manager. If the equipment is to be returned for service, please send it prepaid and insured in the original carton to:

SERVICE MANAGER MedaSonics, Inc.
P.O. Box 4903 (47233 Fremont Blvd.)
Fremont, CA 94539
Tel. (800) 227-8076 (800) 292-9966 (In CA)
(510) 623-0626

Rear Panel
(Figure 25)

CLINICAL USE OF PROBES

Four probes are now available for use with the VERSATONE system. Clinical uses are briefly described below.

Various ultrasonic frequencies and probe shapes are required for different procedures. Generally speaking, higher frequencies in the range 5 to 10 MHz give greater sensitivity for the detection of blood flow. Lower frequencies are used to obtain Doppler shifted echoes from sites deep within the body. Thus, a low ultrasound frequency of 2 to 2.50 MHz is considered to be optimum for fetal heart detection, while a high frequency of approximately 8 MHz is desirable for use in studying flow in digital arteries. Similarly, probe shape can be important. A large flat

probe is convenient for precordial use to detect venous air embolism in the right atrium during neurosurgical procedures, while a very small probe in a pencil shape is useful when Doppler ultrasound is employed intraoperatively, or for blood flow detection in digital arteries.

Each of the probes has been individually adjusted, and no operator tuning or adjustment is necessary to assure optimum performance. The probes may be gas-sterilized. Following such sterilization allow ample time for outgassing from the plastic materials.

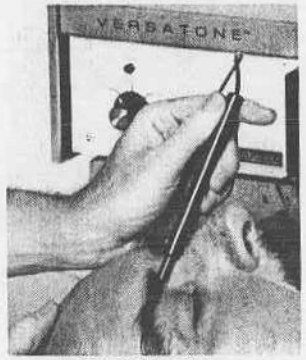
Please note that detailed instructions accompany each probe unit. Read these instructions carefully before attempting any clinical procedure using the probes.

PROBE P81: This unit has a 4 cm diameter circular configuration and operates at a frequency of 2.4 MHz. Its broad surface and low frequency make it suitable for use in precordial monitoring for air emboli in the right atrium of the heart during neurosurgical procedure. The P81 probe is manufactured using special shielding techniques to substantially reduce interference from many electrosurgical instruments. The anesthesiologist can continue monitoring even while the electrocautery is being used. CAUTION: While this technique is effective with the probe properly positioned, improper location may give false negative results. See separate Model P81 probe instructions.

PROBE P81
(Figure 26)
Part #101-0012-010

Mechanical heart action can be monitored using the Model P81 probe positioned on the chest.

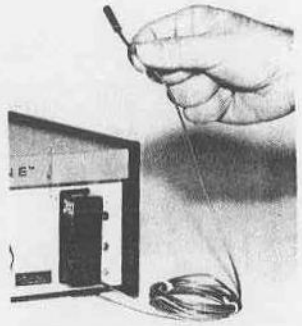
PROBE P82: This is a pencil-shaped probe with a tip diameter of 6 mm and a length of 12 cm. It operates at a frequency of 8 MHz. It is well suited for detecting flow in small arteries and veins close to the body surface, and vessels exposed during surgical procedures. When a probe is used intraoperatively, the body fluids existing in the operative field may serve as the coupling agent. Sterile normal saline solutions labeled for intraoperative use may also be used as a coupling fluid.



PROBE P82
(Figure 27)
Part #101-0013-010

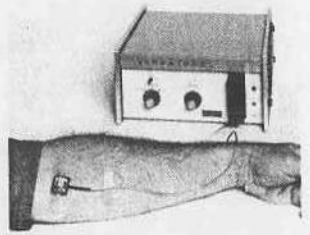
Blood flow in facial arteries and the small arteries of the hands and feet can be assessed using this probe. The probe can be gas sterilized and used intraoperatively.

PROBE P83: This unit has the same diameter and frequency as P82, but is only 2.5 cm long. It is useful in the same application as the P82, particularly when minimum size is required.



PROBE P83
(Figure 28)
Part # 101-0014-010

PROBE P84: This probe has a 2 cm square configuration and operates at a frequency of 5.3 MHz. It is designed to be taped in place on an arm or leg to monitor peripheral blood flow. The pulse wave produced by the heart, can in this way, be monitored. When used with a conventional cuff and manometer, it provides a convenient way of taking systolic blood pressures. Because the probe detects motion rather than sound, systolic pressures may be obtained on young children and patients in shock. Systolic blood pressure can also be taken at the ankle to obtain quantitative measurements useful in the diagnosis and management of peripheral vascular disease. Such pressures can be taken before, during, and after vascular reconstructive surgery.



PROBE P84
(Figure 29)
Part # 101-0015-010

Another important use of the P84 probe is during cardiopulmonary bypass procedures.

CAUTIONS AND SAFETY

Caution: Federal law restricts this device to sale by or on the order of a physician.

1. Improper placement of the Doppler probe can result in an error of interpretation.
2. Sensitivity should be verified whenever Doppler signals are absent at a position where they might normally be expected. Sensitivity of the instrument may be easily verified on one's own circulation.
3. A Doppler probe responds to average velocity of motion and is partially dependent on the angle which the transducer

makes with the direction of motion. Blood must be moving at a speed of several centimeters per second before a Doppler signal may be obtained. The Doppler does not indicate volume of flow. A very low volume flow, at high velocity in a narrow lumen, may be indistinguishable from a high volume flow in a larger lumen. Presence of Doppler flow signals does not necessarily guarantee adequate tissue perfusion.

4. Energy levels of VERSATONE's ultrasonic output are in the very low range customarily used in diagnostic applications. Considerable recent research has been done to assess the effect of ultrasound on biological tissue. References to four of these research studies are listed below. Dunn and Fry[1] conclude that "ultrasound does not present a hazard as currently employed for medical purposes." Nevertheless, unnecessary exposure should be avoided.

5. CAUTION: THE INSTRUMENT IS NOT GAS-TIGHT, AND THUS IS NOT EXPLOSION PROOF FOR USE IN THE PRESENCE OF EXPLOSIVE ANESTHETICS.

6. Safety from electrical hazard is assured by the use of insulated probes and battery operation. Care must be exercised and instructions carefully followed in making connections to tape recorder and chart recorder output jacks to avoid any possible shock hazard. When VERSATONE is operated with the power cable plugged into line current, the unit is third-wire grounded.

7. VERSATONE Model D8 is Underwriters Laboratories listed per UL544 for medical and dental equipment.

NOTE: The Verstone should be operated under battery power during intraoperative procedures to ensure safety from electrical hazards.

REFERENCES:

1. Dunn, Floyd and Fry, Francis S.: "Ultrasonic Threshold Dosages for the Mammalian Central Nervous System" IEEE Transactions on Bio-Medical Engineering, No. 4, July 1971, pp. 253-256.
2. Abdulla, Usama, et al.: "Effect of Diagnostic Ultrasound on Maternal and Fetal Chromosomes," Lancet, October 16, 1971, pp. 829-831.
3. Mermut, Saim: "The Effect of Ultrasound on Human Chromosomes in Vitro, " Obstetrics and Gynecology, Vol. 41, No. 1, January 1973, pp. 4-6.
4. Ulrich, Wesley D.: "Ultrasound Dosage for Nontherapeutic Use on Human Beings—Extrapolations from a Literature Survey," *IEEE TRANSACTIONS on Bio-Medical Engineering*, No. 1, January 1974, Vol. BME-21.
5. Stewart, H.F. et al "Development of Principles and Concepts for Specification of Ultrasound Diagnostic Equipment Performance." Proceedings of the First Meeting of the World Federation for Ultrasound in Medicine and Biology, August 3-7, 1976, in San Francisco, California.

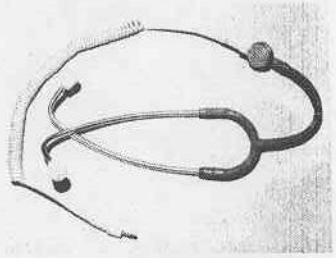
OPTIONS AND ACCESSORIES

OPTION 01: 220 VOLT OPERATION. This option consists of modifications which allow recharging and operating from a 220 volt power source.

OPTION 02: CHART RECORDER OUTPUT. This option consists of additional circuitry which converts the Doppler shifted ultrasound to a signal that can be visually displayed on a chart recorder. The connection is made from the chart recorder jack on the rear panel using the AS1048 connecting cable which is supplied when this option is ordered. The signal corresponds to the variation in average velocity of the motion under investigation. To preclude any possibility of shock hazard, consult the separate connection and operating instructions before making any connections to the chart recorder jack.

HEADSET SH3A: This stethoscope style headset affords private listening when plugged into the jack on the front panel of the VERSATONE.

TAPE RECORDER CABLE HW1069: This cable will connect the VERSATONE to most tape recorders.



SH3A
(Figure 30)
Part # 101-0008-010

FULL WARRANTY

MedaSonics warrants that if during the year after original purchase, your MedaSonics Versatone (the "Unit") fails to perform substantially in accordance with design specifications due to a defect in materials or workmanship MedaSonics will repair, adjust, or maintain the Unit as necessary. THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. This warranty will not apply if the Unit has been tampered with or serviced by an unauthorized person, subjected to liquid immmersion or autoclaving, or otherwise improperly treated. MedaSonics will not be liable for any consequential damages resulting from breach of warranty or loss of use of the Unit, and MedaSonics' liability is limited in all events to the purchase price of the Unit.

SPECIFICATIONS: VERSATONE MODEL D8

Description — A portable Doppler ultrasound unit with built-in loudspeaker and the facility to accept a variety of specially designed plug-in probes.

Cabinet — A rugged metal chassis with ABS plastic side panels, a carrying handle, and provision for probe and accessory storage under a hinged top cover.

Power Supply — An internal rechargeable nickel-cadmium battery pack provides 16 to 24 hours of service. Battery pack can be recharged in 8-12 hours. Unit can be operated while the battery is being recharged.

Line Voltage Range — 105 to 130 volts. A 220 volt option is available. (220 V unit not UL listed)

Electrical Safety — All probes are electrically insulated from the operator and patient. There are no exposed crystals or delicate wires. Transformer leakage (115 volt operation) is less than 12 microamps. Underwriters Laboratories listed per UL544 for medical and dental equipment.

Power Cable — A 7-foot long, detachable, 3-wire grounded cord listed by UL and CSA.

Probe Receptacle — Compatible probes P-81, P-82, P-83, and P-84 plug in easily and are held securely by the receptacle.

Main Switch — A three-position switch provides a *TIMED-ON* position with a duration of approximately one minute, in addition to *ON* and *STANDBY* operating modes.

Volume Control — A control for adjusting the level of Doppler shifted ultrasound output.

Tone Control — A three-position switch for selecting *HIGH*, *LOW* or *NORMAL* frequencies.

Headset Jack — Accepts a 1000 or 2000 ohm headset, MedaSonics model SH3A which automatically shuts off the loudspeaker for private listening.

Tape Recorder Jack — Tape recordings can be made by connecting a suitable cable (MedaSonics HW1069) from this jack to most tape recorders.

Weight — 4 kilograms (8 pounds, 12 ounces).

Size — 25.5 cm wide, 25.5 cm deep, 12.7 cm high (10 inches x 10 inches x 5 inches).

MANUFACTURED IN THE U.S.A. BY

MEDASONICS®

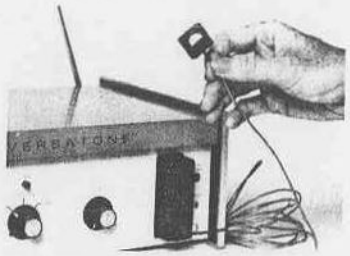
47233 Fremont Blvd.
Fremont, CA 94538
TOLL-FREE TELEPHONE: 800 227-8076

Printed in U.S.A.

INSTRUCTIONS

MEDASONICS

VERSATONE®
P84 PROBE



Probe P84
(Figure 31)
Part # 101-00015-010

DESCRIPTION

The Model P84 probe is a small flat probe with an ultrasonic frequency of approximately 5.3 MHz. It measures approximately 1.9 cm x 1.9 cm and is about 0.9 cm thick. The piezoelectric crystal is semicircular in shape and is set into the probe at an angle of 30°. This probe is provided with an eight-foot connecting cable terminating in a special housing that is plugged into the front panel of the VERSATONE unit. It can be used only with the MedaSonics VERSATONE instrument. Please read the Model D8 VERSATONE instruction booklet as well as these instructions before using the probe.

PRINCIPLES OF OPERATION

The piezoelectric crystal in the probe face is protected from damage by a clear plastic faceplate as well as by its recessed position in the probe. This crystal produces a low power ultrasound signal at a frequency of approximately 5.3 MHz and projects it into the body. Reflections of this ultrasound energy occur at various tissue interfaces. Reflections from moving targets, such as red blood cells, will have their pitch shifted slightly. The extent of the Doppler shift in frequency varies with the velocity of motion of the particular point reflecting the signal. Arriving at the crystal, these reflections are detected, greatly amplified, and converted into audible sounds.

USING THE P84 PROBE

At one end of the eight-foot cable is the small probe containing the piezoelectric crystal. At the other end is the plug housing. Hold the plug housing with the connecting cable at the bottom and match the slot in the housing to the receptacle on the front of the VERSATONE unit. Push firmly to seat the housing into the receptacle. The probe is now ready for use. The VERSATONE instructions cover operation of the instrument controls.

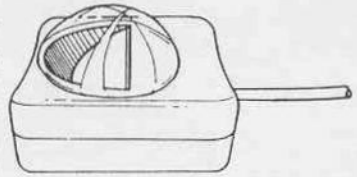
CAUTION: THE MODEL P84 PROBE AND VERSATONE ARE NOT EXPLOSION PROOF. DO NOT USE IN THE PRESENCE OF FLAMMABLE ANESTHETICS.

CLINICAL USE

There are two basic applications for the Model P84 probe:

a) Monitoring peripheral blood flow.
b) Taking systolic blood pressure in adults, children, and infants.

General principles for use of the P84 probe are similar for both applications:



1. Apply a liberal quantity of ultrasound coupling gel to the recessed area of the probe as shown in the illustration. Air entrapment (bubbles) should be avoided. It is essential for proper operation that gel coupling of the crystal face to the skin is complete when the probe is placed in position over the vessel to be monitored. A tube of commercial ultrasound coupling gel is supplied with each instrument.

2. A. Place the probe with coupling gel over the vessel to be monitored. Shift it slightly in order to obtain the loudest and best signal. Finally, tape it firmly in place with any low-residue tape. Avoid taping the probe so tightly that it interferes with the blood flow. It is a good idea to anchor the cable a few inches away from another place of tape. Avoid spreading the gel on skin where the tape must hold. Avoid loss of gel from the recess in the small probe end.

B. If an examination involving handheld searching is to be carried out, it may be desirable to spread coupling gel over the area of interest as well as the recessed area of the probe. If the probe is then to be taped in one place, this should be wiped dry so that the tape will hold, and the procedure described in 2A followed to insure adequate coupling.

C. The sensitivity pattern of the probe is like a searchlight, and some shifting of the probe is necessary to obtain the best flow signals. The frequency (pitch) of the audible flow sounds is related both to flow velocity and to the angle between the probe and the direction of flow. The crystal in the recess is at an angle which provides good results in most applications when the probe is taped flat against the body.

D. In applications during surgery, the Doppler signal may be broadcast into the room so that all personnel can be aware of it, or the speaker may be silenced by using earphones (or earset) while still allowing one person to monitor the signal.

3. The P84 probe can be used in conjunction with a cuff and manometer to obtain Doppler systolic blood pressure. Probe placement should be over an appropriate artery distal to the cuff and not beneath it. Placement over the brachial or radial artery is suitable for arm systolic blood pressure. Placement on the posterior tibial artery is generally satisfactory for measurement of lower extremity systolic blood pressure. Note that in the presence of arterial occlusive disease, ankle blood pressure can be substantially less than arm blood pressure.

Systolic blood pressure is taken by inflating the cuff until blood flow is cut off and the Doppler arterial signal is interrupted. Pressure is the cuff is slowly released and the Doppler systolic pressure is taken to be that pressure at which the Doppler sounds first resume. Caution should be exercised to be sure that inflating the cuff does not cause displacement of the P84 from its original position over the artery.

4. The P84 probe may be gas sterilized. Allow ample time for outgassing from the plastic materials following such sterilization. Several probes may be sterilized and kept in readiness. DO NOT AUTOCLAVE.

5. USE IN PRESENCE OF ELECTROCAUTERY: The cable of the P84 is shielded to prevent interference from electrocautery noise, however the D8 VERSATONE power cord must be disconnected or it may defeat this shielding by acting as an antennae. The D8 is of course designed to operate on its self-contained rechargeable battery.

REFERENCES

The references cited refer to procedures using Doppler ultrasound in which use of the P84 Probe is applicable.

1. Waltemath, C. L., Preuss, D. D.: Determination of blood pressure in low-flow states by the Doppler technique. *Anesthesiology*, 34:77-79, 1971.

2. Lichti, E. L., et al: Cardiac massage efficacy monitored by Doppler ultrasound flowmeter. *Missouri Medicine*, 68:317-320, 1971.

3. Waltemath, C. L., Preuss, D. D.: Assessment of cardiovascular function during operation using Doppler technique. *The American Surgeon*, 352-354, June 1972.

4. Lowry, R. L., Lichti, E. L., Eggers, G. W. N.: The Doppler: An aid in monitoring blood pressure during anesthesia. *Anesthesia & Analgesia*, 52:531-535, 1973.

5. Hernandez, A., Meyer, D. A., Goldring, D. "Blood Pressure in Neonates." *Contemporary OB/GYN*, 5 (March 1975) 34-37.

CARE AND SERVICE

1. The probe faceplate area should be cleaned carefully after each use. A cotton swab is recommended for cleaning out the recessed area. Use water or a soap solution. Do not use alcohol or organic cleaning preparations. Do not immerse in liquids. DO NOT AUTOCLAVE.

2. IS IT WORKING? A quick check can be made by listening to one's own vascular sounds to verify sensitivity. This should be done whenever Doppler signals are absent at a point where they might normally be expected. In the event of any difficulty, make sure the unit is "ON", the volume control is turned up, the probe tip is free of dried residue, and that enough coupling agent is being used.

3. MedaSonics, Inc. maintains a service facility which has the capability to promptly repair all products returned to the factory. Prepaid insured shipment for factory service should be made to:

SERVICE MANAGER MedaSonics, Inc.
47233 Fremont Blvd.P.O.Box4903 Fremont,CA 94539

Telephone inquiries about service may be made by calling the Service Manager. Toll-free telephone 800 227-8076.

FULL WARRANTY

MedaSonics, Inc. warrants that your MedaSonics Model P84 Doppler probe is free from defective material and workmanship. Our obligation under this warranty is limited to the repair of instruments returned to us, transportation charges prepaid, within one year after delivery to the original purchaser. Specifically, we agree to service and/or adjust any instrument as required if returned for that purpose and to replace or repair any part which, upon our examination, is proved to have been defective. This warranty does not apply to equipment damaged through shipping, tampering, negligence or misuse, including liquid immersion and autoclaving. THE FOREGOING WARRANTIES ARE EXCLUSIVE AND ARE IN LIEU OF ALL OTHER WARRANTIES (whether written, oral or implied). MedaSonics is not liable for consequential damages.

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MEDASONICS

47233 Fremont Blvd.
Fremont, CA 94538
TOLL-FREE TELEPHONE: 800 227-8076

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